BOTANICAL GAZETTE

JULY, 1894.

Undescribed plants from Guatemala and other Central American Republics.[1] XIII.

JOHN DONNELL SMITH.

WITH PLATES XXIV—XXVI.

Heisteria Costaricensis Donnell Smith. (§ LEIOCARPÆ Engl.)—Folia disticha anguste lineari-lanceolata juxta basim acute angustata supra medium sensim in apicem mucrunculatum attenuata, margine adpresse retroflexo, petiolo brevi decurrente. Calyx urceolatus post anthesim retroflexus pedicelli dimidium æquans, dentibus brevibus triangularibus in setam desinentibus. Petala libera obovata ad apicem emarginata calyce sublongiora. Ovarium perianthium paullo superans latior quam longior collo coronatum. Calyx fructiferens coriaceus patulus pentagono-orbicularis cum pedicello breviore sanguineus subtus maculis albis notatus. Drupa ovata-globosa calycis radio brevior atro-cyanea.

A large bush with slender, drooping, and closely leafy branches that are toward their tips flexuose and angulate. Leaves 6–8^{lin} × 9–11^{l}, membranaceous, pellucid-punctulate, glaucescent beneath. Petiole 3–4^{l} long, decurrent in narrow wings. Flowers scarcely a line high, apparently solitary. Stamens not seen. In fruit, pedicel 3½–4½^{l} long, calyx 10–12^{l} in diam. Drupe 5×4^{l}.—The only other species described, with similarly narrow leaves, *H. salicifolia* Engl. from South Brazil, is distinct by its calyx, which in fruit is cupuliform, deeply lobed, plicate and enclosing the pale drupe.—Forest on Rio Reventazón, Prov. Cartago, Costa Rica, alt. 2,000^{ft}, Mch. 1894, J. D. S., (ex Plantis Guatemalensibus necnon Salvadorensibus Hondurensibus Nicaraguensibus Costaricensibus, quas edidit John Donnell Smith, 4,760).

[1] The title of these papers, as well as that of the tickets accompanying the distribution of plants, has been changed to the form here employed, in order to include in the series some collections from other parts of Central America.

Cuphea Heydei Koehne (inserenda post *C. Liebmannii* Koehne in Engler's Bot. Jahrbüch. **2**: 409. 1882. Sect. x. MELVILLA Koehne, subsect. 5. Erythrocalyx Koehne). ICON: Koehne Atlas Lythracearum ined. *t. 44. fig. 380.*—Fruticulus *ramis junioribus dense hispidis* vetustioribus glabratis. Folia internodiis 2–3-plo longiora, basi acuta vel in petiolum 1–4^{mm} longum hispidum attenuata, elliptica v. lanceolata (24–54^{mm}: 11–17^{mm}), longe acuminata, parce ciliata, superiore pagina parce, inferiore in nervis densius hispida, vix rigidula, subtus pallidiora. *Flores solitarii; pedicelli axillares* 9–20^{mm} æquantes, parce hispidi, prophylla minutissima, quasi in setas 3–4 dissoluta summo apice gerentes. Calyx (22–26^{mm}) calcare orbiculari dilatato subincurvo (fere 3^{mm} longo latoque) instructus, subrectus, subgracilis, infra faucem ascendentem valde dilatatam plicatam subangustatus, verisimiliter intense coccineus, infra medium hispidus, intus glaberrimus; *lobi brevissimi, setis 4–6 ciliati; appendices lobis longiores, dorso seta valida munitæ. Petala* 0 *v. duo dorsalia minutissima subulata.* Stamina ad tubi $\frac{4}{5}$ lineæ rectæ inserta; episepala fere $\frac{1}{3}$ supra tubum exserta; epipetalorum 4 ventralia lobos aequantia, 2 dorsalia paullo breviora et ceteris vix inferius inserta; omnia glaberrima. Stylus glaberrimus, sub anthesi ovarium glaberrimum duplum aequans, demum circ. 8^{mm} exsertus. Discus crassus, ovato-cordatus, deflexus, supra sulcatus, subtus convexus. Ovula 9–14.—A *Cuphea Liebmannii* Koehne proxima differt calycibus majoribus appendicibus manifestis seta munitis et praecipue pedicellis axillaribus nec interpetiolaribus.

Nebáj, Depart. Quiché, Guatemala, alt. 7,000^{ft}, May 1891, Heyde & Lux, no. 4,480.

IPOMÆA FISTULOSA Mart., var. **Nicaraguensis** Donnell Smith.—Volubilis, foliis cordiformibus acuminatis discoloribus supra pubescentibus subtus cano-velutinis. Sepala pubescentia orbicularia. Corolla ad 3–4-pollicaris. Semina flavocomosa.

Rio de Las Layas, Depart. Rivas, Nicaragua, alt. 120^{ft}, April 1893, Dr. W. C. Shannon, U. S. Army, no. 5,046.

Salvia Shannoni Donnell Smith. (§ CALOSPHACE.)—Suffrutex cano-pubescens. Folia ovato-lanceolata sensim acuminata ad basim acuta obtusave serrulata discoloria supra scabriuscula subtus cum petiolis velutina, floralia subconformia contractius acuminata flores superantia. Racemorum

breviter pedunculatorum verticillastra coarctata 6–14-flora, infirma subremota. Calycis subsessilis tubuloso-campanulati labia late ovata, posticum integrum anticum acute dentatum. Corolla quam calyx duplo fere longior ad medium subæqualiter labiata, tubo gracili vix ventricoso sub exserto, labii inferioris lobo medio reniformi bifido. Stylus superne unilateraliter fimbriatus.

Leaves 3–4 × $1\frac{1}{4}$–$1\frac{3}{4}$^{in}, petioles 6–8^{l} long. Racemes 3–5^{in} long; bracts sessile, herbaceous, pubescent, purplish, persistent, 8–10 × 4–5^{l}. Calyx pubescent, virescent or colored, 5^{l} long, lips $1\frac{1}{2}$^{l} long. Corolla blue, 8^{l} long, nearly glabrous galea 3^{l} long; lip pubescent on back, 4^{l} long, middle lobe $1\frac{1}{2}$ × 3^{l}. Filament produced at articulation; anterior branch of connective $1\frac{1}{2}$^{l} long, not dilated, glabrous, dentate. Inferior lobe of style $\frac{1}{2}$^{l} long, the superior thrice longer.—Slopes of Volcan Chingo, Depart. Jutiapa, Guatemala, alt. 3,000^{ft}, Oct. 1892, Dr. W. C. Shannon, U. S. Army, no. 3,612.

Triplaris Macombii Donnell Smith.—Folia pedalia oblique lateque elliptico-ovata abrupte acuminata ad basim late rotundata glabrata subtus rubro-punctulata, margine pilosiusculo, costa subtus adpresse pilosa. Racemi feminei (qui soli suppetunt) singuli aut bini aut terni ex summis axillis orti itidem in paniculam terminalem folia superantem congesti. Calycis fructiferentis lobi exteriores quam tubus oblongus altero tanto longiores linguiformes, sinuum late rotundatorum marginibus retroflexis, lobi interiores tubum subæquantes eique $\frac{2}{3}$-adnati setaceo-subulati ad basim plus minus appendiculati. Nuculæ nitidæ quam tubus $\frac{1}{3}$ brevioris facies ovatæ, stylis fauces haud attingentibus.

Branchlets smooth, sulcate, verrucose at nodes. Leaves membranaceous, undulate, inequilateral, 10–13 × 6–7^{in}; caudate acumination blunt, 5^{l} long; nervation immersed above, salient beneath, 17–19 lateral nerves straight and uniting in arches remote from margin, reticulation minute, longitudinal impressions nearly obsolete; petiole 8–11^{l} long. Panicle densely flavo-sericeous, rachis flexuose; racemes densely flowered from near base, 8–12^{in} long; bracts persistent, acuminate-ovate, margins continuing united below, within plurinerved and colored; pedicels as long (4^{l}), deflexed. Calyx of matured fruit 26^{l} long, pale-yellow; tube appressed-villose, 9 × 3^{l}; wings sparsely pilose, 17 × 5^{l}, obtuse, narrowed toward base; interior lobes somewhat unequal, about 3^{l} long.

Nutlet $5 \times 3\frac{1}{2}^{l}$, styles 2^{l} long.—Most nearly related to *T. auriculata* Meisn. and *T. Arnottiana* Meisn., the originals of which in the Meisner herbarium of Columbia College have been compared.—Jiquilisco, Depart. Usulután, Salvador, alt. 220^{ft}, Jan. 1893, Dr. W. C. Shannon, U. S. A., no. 5,064. Named for Lieut. M. M. Macomb, U. S. Army, Engineer in Charge, Corps no. 1, Intercontinental Railway Commission.

Piper flavidum C. DC. in Donnell Smith Enum. Pl. Guat. **2**: 66; (§ III. STEFFENSIA C. DC.); foliis brevissime petiolatis lineari-lanceolatis basi æquali acutis apice acute acuminatis mucronulatisque utrinque glabris, nervo centrali circiter ad $\frac{1}{4}$ longitudinis nervos utrinque 3 alternos adscendentes mittente, petiolo glabro basi ima vaginante, pedunculo glabro petiolum superante, amento florente folii dimidium æquante, bracteæ vertice triangulari margine flavide hirsuto, bacca subtetragona apice subtiliter flavide hirtella.—Ramuli glabri internodiis brevibus, corticis collenchymate continuo zona fibrosa continua intus aucto, fasciculis intramedullaribus 2-seriatis. Limbi 8^{cm} longi 13^{mm} lati in sicco firmuli flavicantesque. Petioli ad 2^{mm} longi. Pedunculi 6^{mm} longi. Amentia florentia 3^{mm} crassa. Stamina 4.

Barranca de Rubelcruz, Depart. Alta Verapaz, Guatemala, alt. 2,500^{ft}, Apr. 1889, J. D. S., no. 1,744.

Piper Tuerckheimii C. DC. in Donnell Smith Enum. Pl. Guat. **2**: 96; (§ III. STEFFENSIA C. DC.); foliis modice petiolatis, limbis 3^{cm} supra basin peltatis oblongo-ovatis basi rotundatis leviterque repandis apice acute acuminatis supra glabris subtus præsertim ad nervos hirtellis, nervo centrali circiter ad $\frac{1}{2}$ longitudinis nervos utrinque 3 oppositos adscendentes mittente, lateralibus 4–5 e basi solutis tenuibus, amento quam folium pluries breviore apice longe mucronato, pedunculo quam petiolus pluries breviore, bracteæ apice truncato-peltatæ pelta triangulari margine hirtella, bacca subglobosa vertice hirsuta.—Ramuli dense hirtelli. Limbi ad 24^{cm} longi ad 12^{cm} lati. Petioli 4.5^{cm} longi hirtelli basi vaginantes. Pedunculi 8^{mm} longi hirtelli. Amenti pars baccifera 5^{cm} longa mucro 2^{cm} longus hirtellus. Stamina 4.

Pansamalá forest, Depart. Alta Verapaz, Guatemala, alt. 3,800^{ft}, Aug. 1886, von Türckheim, no. 1,038.

Piper Santa-rosanum C. DC. in Donnell Smith Enum. Pl. Guat. **2**: 96; (§ STEFFENSIA C. DC.); foliis modice petiolatis

oblique rotundato-ovatis basi inæquali rotundatis subcordatisque apice obtusiuscule acuminatis utrinque dense velutinis 7-nerviis nervis 5 medianis validioribus, petiolo dense velutino basi ima vaginante, amento baccifero limbum æquante, pedunculo petiolum parum superante velutino, bractea spathulata apice rotundata utrinque et præsertim dorso hirsuta, ovario hirtello, bacca globoso-ovata hirtella.—Frutex 3–4^{m} altus. Ramuli dense velutini, cortex fasciculis collenchymateis discretis instructus fibris destitutus, fasciculi intramedullares uniseriati. Folia in sicco subrubescentia. Limbi in sicco firmi circiter 12^{cm} longi 7.5^{cm} lati. Petioli 1^{cm} longi. Amenta baccifera 3^{mm} crassa. Stamina 4, antheræ reniformi-globosæ caducæ filamentis circiter æquilongæ.

River-bank near Santa Rosa, Depart. Baja Verapaz, Guatemala, alt. 5,000^{ft}, Apr. 1887, von Türckheim, no. 1,174, distributed as *P. patulum* Bertol.; Santa Rosa, Depart. Santa Rosa, Guatemala, alt. 4,000^{ft}, May 1892 and Nov. 1892, Heyde & Lux, nos. 3,463 and 3,833; Capetillo, Depart. Zacatepequez, Guatemala, alt. 4,300^{ft}, Mch. 1892, J. D. S., no. 3,590.

Piper variabile C. DC. in Donnell Smith Enum. Pl. Guat. **2:** 66; (§ IV. CARPUNYA C. DC.); foliis modice petiolatis late ovatis basi truncato-rotundatis vel elliptico-ovatis basi subacutis omnibus apice acuminatis utrinque glabris, nervo centrali nervos ad $\frac{2}{3}$ longitudinis utrinque circiter 5 sursumque nervulos validos mittente, petiolo glabro basi ima vaginante, amento folium subæquante pedunculo quam petiolus paulo breviore, bracteæ vertice glabro triangulari superne breviter acutato unde subquadrangulari pedicelloque basi hirsuto, bacca obpyramidato-trigona glabra.—Ramuli glabri. Limbi in sicco subcoriacei opaci fuscescentes late elliptici 16.5^{cm} longi 12.5^{cm} lati, elliptico-ovati 16^{cm} longi 8.5^{cm} lati. Petioli 1.5^{cm} longi. Amenta baccifera ad 6^{mm} crassa. Stamina 3.—Species foliorum forma in ramis amentiferis ipsis valde variabili insignis.

Mountain-forests near Coban, Depart. Alta Verapaz, Guatemala, alt. 4,300^{ft}, May 1879, von Türckheim, no. 434.

Piper Donnell-Smithii C. DC. in Donnell Smith Enum. Pl. Guat. **2:** 95; (§ IV. CARPUNYA C. DC.); foliis breviter petiolatis lanceolatis basi æquali acutis apice longiuscule acute acuminatis utrinque glabris, nervo centrali circiter ad medium nervos utrinque 5 nervulosque validos mittente, peti-

olo basi ima vaginante, pedunculo petiolum æquante, amento quam folium pluries breviore, bracteæ apice turncato-peltatæ vertice triangulari margine hirtello pedicelloque lato hirtello, bacca parce hirtella.—Ramuli glabri tenues, cortex collenchymate proprio destitutus zona fibrosa continua instructus, fasciculi intramedullares sub-2-seriati. Limbi ad 13^{cm} longi ad 4^{cm} lati, in sicco membranacei nigrescentes opaci. Petioli 7^{mm} longi. Amenta submatura ad 4^{cm} longa 3^{mm} crassa. Stamina 3. Bacca obpyramidato-trigona in sicco nigra.—Species *P. eucalyptifolium* Rudge mire simulans amentis angustioribus ramulis haud uno latere hirtellis et verisimiliter staminum numero ab eo discrepans, a *P. concinno* C. DC. bracteæ pelta hirtella, a *P. Costaricense* C. DC. amentis brevioribus distincta.

Pansamalá, Guatemala, alt. $4{,}000^{ft}$, July, 1886, von Türckheim, no. 975.

Peperomia Cobana C. DC. in Donnell Smith Enum. Pl. Guat. **2**: 66; foliis alternis longiuscule petiolatis lanceolatis utrinque glabris, nervo centrali nervos utrinque 4–5–6 mittente, amentis apice caulis et ramuli axillaris aphylli 3 alternis foliorum limbos circiter æquantibus, ovario basi rhachi impresso apice oblique subulato antice stigmatifero.—Erecta glabra. Limbi ad 13^{cm} longi ad 5^{cm} lati in sicco subcoriacei opaci nervis ægre cernendis. Petioli ad 3^{cm} longi. Ramuli amentiferi pars infera sterilis 9^{cm} longa. Amenti pedunculus ad 2^{cm} longus. Amentum ipsum circiter 1^{mm} crassum. Bractea orbicularis.—Species *P. lancifoliæ* Hook. proxima petiolis multo longioribus ab ea præcipue discrepans.

Near Coban, Guatemala, alt. $4{,}600^{ft}$, June, 1879, von Türckheim, no. 78.

Peperomia Luxii C. DC.; foliis quaternis modice petiolatis e basi cuneato-obovatis apice emarginulatis utrinque glabris indistincte 3-nerviis in sicco coriaceis, amentis terminalibus pedunculatis pedunculos suos circiter duplo foliorumque limbos circiter triplo superantibus densifloris, rhachi glabra, bractea orbiculari coriacea centro pedicellata, ovario semiimmerso ovato in stylum gracilem apice stigmatiferum terminato, bacca ovata stylo ea breviore apice mucronata.—Herba procumbens glabra, caule in sicco coriaceo 4-sulcato vix 2^{mm} crasso. Limbi opaci circiter 15^{mm} longi 8^{mm} lati. Petioli circiter 3^{mm} longi. Pedunculi 2^{cm} longi. Amenta matura ad 5^{cm} longa 1^{mm} crassa.

Ojo de Agua, Depart. Santa Rosa, Guatemala, alt. 3,500ft, Sept., 1892, Heyde & Lux, no. 3,828.

Phoebe amplifolia Mez et Donnell Smith; foliis amplissimis, adultis supra glabris nitidisque vel secus nervos adpresse tomentellis, dense nervis immersis areolatis, subtus tomento brevi puberulo, ad nervos ferrugineo mollibus, latissime ellipticis, apice breviter subacuminatis, penninervibus; inflorescentia dense ferrugineo-tomentella, submultiflora, laxiuscule paniculata, foliis multo breviore; floribus dense ferrugineo-tomentellis; limbi segmentis æqualibus, subobtusis; filamentis pilosis quam antheræ multo brevioribus; antheris omnibus 4-locellatis; ovario glaberrimo.—Arbuscula videtur (ex ramorum habitu), ramulis crassis, dense adpresseque ferrugineo-tomentellis basin versus cinerascentibus, striatim subangulatis; gemmis dense ferrugineo-tomentosis; cortice esipido, paullo mucoso. Folia petiolis usque ad 32mm longis, validissimis, supra profunde canaliculatis, tomento peradpresso brevissimoque adultioribus cinereo obtectis stipitata, sparsa, rigide coriacea, supra (præter nervos adpresse cinereo-tomentellos) adulta saltem glabra nitidaque et dense venulis immersis areolata, subtus tomento brevi puberulo, ad nervos ferrugineo mollia valde prominenti-reticulata, latissime elliptica, basi breviter acuta apice breviter lateque subacuminata, ex specimine nostro usque ad 0.3m longa, 0.16m lata, costis e nervio medio sub angulo 45–60° prodeuntibus, margine quam maxime recurvato, in statu sicco præsertim basin versus solemniter lateque replicato. Inflorescentia laxiuscule panniculata late subthyrsoidea, dense adpresseque tomento ferrugineo obtecta, foliis permulto brevior; pedicellis sæpius 4mm vel paullo infra longis, bracteolis deciduis. Flores dense adpresseque ferrugineo-tomentelli, limbi segmentis quam genitalia multo longioribus, æqualibus, lingulatis, apice subobtusis. Filamenta pilosa quam antheræ multo breviora, ser. III basi glandulis binis magnis, sessilibus aucta. Antheræ subquadraticæ, obtusæ, omnes quatrilocellatæ, locellis ser. II exteriorum introrsum, ser. III sublateraliter dehiscentibus. Staminodia perconspicua filamento manifesto, piloso stipitata. Ovarium glaberrimum, subglobosum; stylo crasso subæquilongo; stigmate pulvinato. Bacca maxima (± 33mm longa, 22mm diam. metiens), bene ellipsoidea, cupulæ crassæ, subpateriformi, obscure duplicimarginatæ, sensim conice in pedicellum valde incrassatum transeunti insidens.

El Jute, Depart. Quiché, Guatemala, alt. 10,000ft, Apr. 1892, Heyde et Lux, no. 3,033.

EXPLANATION OF PLATE XXIV.—Fig. 1, flowering and fruiting branch.—Fig. 2, posterior view of stamen ser. 1.—Fig. 3, anterior view of stamen ser. 3, with glands —Fig. 4, posterior view of stamen ser. 4.—Fig. 5, Pistil. (Fig. 1 is natural size; the others are variously enlarged.)

Nectandra Heydeana Mez et Donnell Smith; foliis adultis præter costarum axillas subtus sæpius perconspicue barbellatas glabris, optime ellipticis, basi nunc rotundatis nunc breviter acutis, apice sueto acumine brevi sed eleganti præditis, utrinque valde prominulo-reticulatis; inflorescentia subcorymbosa vel subpyramidata, glaberrima; floribus hermaphroditis, glabris, ± 7mm diam. metientibus; filamentis ser. I, II nullis; ovario glabro, stylo subæquilongo. — Arbuscula 12–24ped alta (ex cll. Heyde et Lux!), ramulis glaberrimis, atris vel cinerascentibus, apicem versus lineatim angulosis, gemmis dense sulfureo-strigulosis nonnunquam minute sericantibus, cortice esipido. Folia petiolis usque ad 20mm longis (sed sæpius conspicue brevioribus quoque), supra leviter canaliculatis, sub lente primum peradpresse sulfureo-strigulosis demum glabratis stipitata, sparsa, tenuiter membranacea vel membranacea, præter costarum axillas subtus sæpius perconspicue barbellatas glaberrima, utrinque valde prominenti-reticulata supra (sicca) olivacea nitida, subtus minute rubenti-viridia subnitida, optime elliptica, basi sueto rotundata rarius breviter acuta, apice sæpius acumine brevi sed eleganti prædita, ± 0.16m longa, 72mm lata, costis e nervio medio sub angulo 50–60° prodeuntibus, margine haud recurvulo, sæpius eleganter undulato. Inflorescentia subpauciflora, subcorymbose vel subpyramidatim panniculata, glaberrima, foliis brevior; pedicellis longis (sæpius 7mm metientibus); bracteolis deciduis. Flores hermaphroditi, glabri, ± 7mm diam. metientes, limbi segmentis patentibus, æqualibus, ellipticis, apice rotundatis. Filamenta ser. I, II desunt; ser. III glabra sed generis ritu papillosa, antheris duplo vel ultra breviora, percrassa, basi glandulis binis minutis, globosis, sessilibus aucta. Antheræ ser. exteriorum suborbiculares, apice bene rotundatæ, papillosæ. Ovarium glabrum, subglobosum, stylo crasso, subæquilongo. Fructus ignotus.

Santa Rosa, Depart. Santa Rosa, Guatemala, alt. 3,000ft, Nov. 1892 and Jan. 1893, Heyde et Lux, nos. 4,260 and 4,578.—PLATE XXV.

Pedilanthus macradenius Donnell Smith. (§EUPEDILANTHUS Boiss.)—Folia glabra ampla obovato-oblonga angulo obtusissimo terminantia, basi obtusa. Cymæ ex axillis supremis ortæ breves oligocephalæ, bracteis oblongo-ovatis pedunculos superantibus. Involucrum ad basim rectangulare, calcaris quam tubus paullo minoris deflexi glandulas 2 majusculas gerentis labiis ovatis sub apice plica intrusa auctis, tubi lobis binis inferioribus ovatis cano-fimbriatulis superiore cum intermediis aequilongis alte connato. Bracteolæ numerosissimæ flores masculos aequantes, pedicellis masculis et femineo filamentisque glabris. Capsula depresso-sphaerica lineis dehiscentiæ 6 latis albis notata.

Arboreous. Leaves olive-green, at apex of branchlets 4–6 × 2–3^{in}; petioles smooth, 3^{l} long. Bracts rubescent beneath hoary pubescence, 6 × 3^{l}. Peduncles pubescent. Involucre rubescent, smooth within, 5–6^{l} long, spur 3½ × 2^{l} with oval glands 1^{l} long, tube 4 × 3^{l}. Capsule 4^{l} in diam., coccules ecarinate, seeds trigonal-globose.—Canival, Depart. Huehuetenango, Guatemala, alt. 3,200^{ft}, Dec. 1891, Dr. W. C. Shannon, U. S. Army, no. 412.

Æchmea Friedrichsthalii Mez et Donnell Smith; foliis super vaginam longe paullo angustatis, spinulis minutis armatis vel interioribus saepius fere omnino inermibus; inflorescentia bipinnatim vel imperfecte tripinnatim panniculata, e ramulis distiche florigeris subpatentibus composita, densiuscula subellipsoidea; bracteolis florigeris reflexo-patentibus, latissime ovatis breviterque (nec pungenter) acuminulatis, ovarii medium haud attingentibus; floribus ad 17^{mm} longis, sessilibus; sepalis liberis vel minutissime tantum connatis, apice in aciculum minutissimum (fructiferis saepius deciduum) dorsalem productis; petalis in spinulam terminalem desinentibus, altiuscule ligulatis; filamentis ser. II cum petalis peralte connatis; placentis interno loculorum angulo apici affixis.—Epiphyta (ex cl. Friedrichsthal !), acaulis, florifera ad 0.5^{m} alta. Folia e vagina ovali, margine nunc integerrima nunc dissite spinulis parvis, patentibus aucta, praesertim dorso adpresse allutaceo-lepidota in laminam ensiformem producta, saepius 0.6^{m} vel paullo ultra longa, submembranacea vel tenuiter chartacea, apice longius breviusve acuta, spinulis haud ultra 1^{mm} longis praedita vel interiora fere subinermia, interiora saltem apicem versus pulchre rubentia, subglabra. Inflorescentia multiflora, apicem usque e ramulis distiche florigeris, subpatentibus, vix

ultra 55^{mm} longis composita, foliis brevior, in scapi gracilis, glabri vel perparce lepidoti, vaginis pulchre rubentibus membranaceis, suberectis, lanceolatis perlongeque acutis, inferioribus margine minutissime spinulosis superioribus integerrimis, paullo lepidotis, internodia superantibus praediti apice elata, ovoidea vel ellipsoidea, ±0.15^{m} longa, 90^{mm} diam. metiens, glaberrima; ramulis conspicue undulatis, 6–10-floris; bracteis primariis infimis anguste lanceolatis, peracutis, ramulos axillares ultra dimidium aequantibus, reflexis; bracteolis florigeris 3.5–5^{mm} longis, reflexo-patentibus, submembranaceis, tenuissime solum saepiusque obscure venoso-lineatis, glabris, latissime ovatis breviterque (nec pungenter) acuminulatis, satis concavis. Flores per anthesin secus ramulos stricte erecti, sessiles, 17^{mm} longi, glabri; sepalis liberis vel basi minutissime solum connatis, 5.5^{mm} longis, apice in aciculum minutissimum, brunneum, dorsalem productis, latere tecto in alam maximam aciculo multo altiorem dilatatis. Petala 13^{mm} longa, ex ungue lineari in laminam angustam, sublanceolatam, peracute in spinulam terminalem transeuntem dilatata, 2^{mm} a basi ligulis binis profunde fimbriato-incisis aucta. Stamina petalis paullo breviora, filamentis anguste linearibus, tenuibus, ser. I liberis, ser. II cum petalis peralte (ultra laminæ basin) intime connatis; antheris luteis, fere 3^{mm} longis, lanceolatis, utrinque sed praesertim apice acutis, prope medium dorsifixis. Ovarium subglobosum, longitudinaliter sulcatum, ad 7^{mm} longum; tubo epigyno subnullo; stylo antheras exacte aequante, gracili; stigmatibus longe divisis, perangustis, laxe spiraliter contortis. Bacca cœrulea !, globosa, *Pisi* magnitudine, sepalis persistentibus tenuiter conice conniventibus coronata; seminibus allutaceis, vix 2^{mm} longis.

Isla de Catina, Rio San Juan, Nicaragua,[1] 1839, Friedrichsthal, no. 609, (herb. Vindob.). Rio Jiménez, Llanos de Santa Clara, Comarca de Limón, Costa Rica, alt. 650^{ft}, Apr. 1894, J. D. S., no. 4,962.

Pitcairnia puberula Mez et Donnell Smith; foliis exterioribus ignotis, interioribus haud petiolatis, anguste lanceolatis, integerrimis, subtus junioribus lepidibus albis pilos magnos simulantibus furfuraceis; inflorescentia simplicissima,

[1] Mr. Hemsley has remarked, that all of Friedrichsthal's plants in the Kew herbarium are ticketed as from Guatemala; and this is the case also with the Vienna specimen above cited. In fact, the collections were made in Nicaragua and Costa Rica.

medium usque laxiuscule, apicem versus dense racemosa, multiflora; foliolis scapalibus internodia longe superantibus; bracteis maximis, triangulo-lanceolatis, infimis flores axillares triplo vel ultra superantibus; floribus pedicellis brevibus crassisque stipitatis; sepalis anguste triangularibus, haud carinatis; petalis eligulatis; seminibus utroque polo tenuiter caudatis.—Imperfecte solum cognita, florifera vix ultra 0.4^{m} alta. Folia rosulæ desunt. Scapus validus, erectus, foliis permanifeste brevior, lepidibus araneosis cinereis vel albidis puberulus, dense foliolis iis rosulæ absque dubio æqualibus, anguste lanceolatis, longe peracutis, viridibus, supra glabris subtus junioribus lepidibus albidis pilos magnos simulantibus dense furfuraceis, adultis ± perfecte glabratis, omnibus erectis internodiaque perlonge superantibus, inflorescentiamque medio fere æquantibus usque ad 18^{mm} latis, omnino inermibus instructus. Inflorescentia simplicissima, medium usque laxiuscule apicem versus dense racemosa, paullo infra 0.2^{m} longa, 40^{mm} diam. metiens, cylindrica apiceque rotundata, multiflora; rhachi recta, haud vel vix angulata, lepidoto-puberula; bracteis inflorescentiæ basin versus persensim in folia scapalia transeuntibus triangulo-lanceolatis longissimeque acutis, erectis, infimis flores axillares triplo vel ultra superantibus, supremis quam sepala subduplo brevioribus. Flores deflorati fructiferi solum cogniti stricte erecti, pedicellis percrassis, lepidoto-puberulis, haud ultra 4^{mm} longis stipitati; sepalis subglabris, ad 21^{mm} longis, e basi 5^{mm} lata in apicem acutam sensim angustatis triangularibus, symmetricis, haud carinatis. Petala (nonne revera, ut ex sicco videtur alba vel lutea?) eligulata. Genitalia ignota. Capsula matura ± 18^{mm} longa, ad $\frac{5}{6}$ longit. supera, tenuiter conice perlongeque acuta, basin usque dehiscens, seminibus 2.5^{mm} longis, fere rectis, utrinque cauda tenui egregiaque appendiculatis.—Obs. Species persingularis, Eupitcairnieis adscribenda sed pedicellis crassis bracteisque infimis saltem perelongatis quam maxime notabilis. Binæ adhuc solum hujus gregis species e Guatemala allatæ mihi cognitæ, quæ petalis eligulatis gaudent, utraque infeliciter imperfecta solum mihi ante oculos. (Mez.)

Cenaguilla, Depart. Santa Rosa, Guatemala, alt. 4,000^{ft}, Sept. 1892, Heyde & Lux, no. 3,879.

Anthericum apodastanthum Donnell Smith. (Subgenus Hesperanthes Baker.)—Folia radicalia linearia graminoidea valde 15–17-nervata, margine vix ciliolato. Scapus sesqui-

pedalis teres glaber ebracteatus. Racemus (in exemplaribus mihi suppetentibus) simplex flexuosus, nodis inferioribus remotissimis. Bracteæ interiores ovatæ cuspidatæ, exteriores lanceolatæ denique subulato-attenuatæ. Pedicelli terni in medio articulati. Perianthii segmenta perspicue 3-nervata, interiora in sicco lutea. Filamenta muriculata nunc ovarium aut antheras aequantia nunc eis duplo longiora. Stylus nunc ovarii nunc perianthii longitudinem aequiparans. Capsula oblongo-ovalis perianthio marcido ½ brevior semina in loculo quoque 9–10 habens.

Rhizome not seen. Leaves 12–15^{in} × 2–3^{l}. Raceme 7–8^{in} long, lower internodes 1½–3^{in} long, exterior bracts at length 1^{in} long, pedicels 4–9^{l} long. Perianth 6–7^{l} long. Anthers 1½^{l} long.—Indicated by Mr. J. G. Baker as undescribed and nearest to his *A. Skinneri*.—San Bartolo, Depart. Zacatepequez, Guatemala, alt. 5,000 ^{ft}, May, 1890, Heyde & Lux, no. 4,644.

Gymnogramme sciatraphis Donnell Smith.—Stipites e caudice brevi crasso caespitosi graciles spithamæi straminei glabri, basi paleacea. Frondes acuminato-ovatæ pedales glabræ 4–5-pinnatim decompositæ, jugis plurimis confertis, pinnis pinnulisque oppositis e basi truncata subsessili ovatis lanceolatisve, pinnis infimis maximis, pinnulis ser. II rhomboideis 1–2-fidis, ultimis ellipticis deorsum attenuatis plerumque bifurcatis, segmentorum nervio unico infra medium usque ad furcam sorifero.

Scales ovate, 3–4^{l} long, rigid, blackish, imbricating. Stipes and rachises canaliculate. Sterile and fertile fronds similar, 20–26-jugate. Basal pinnæ accuminate-deltoid, spreading, incurved, 6–7½^{in} long, 15–20-jugate; its lower pinnules 2^{in} long, 9–12-jugate. Segments oblong, acute, 1–1½^{l} long, fruit-dots cylindrical.—To be grouped with *G. chaerophylla* Desv. and *G. schizophylla* Baker, which differ chiefly by absence of caudex and of scales, circumscription and loose pinnation of fronds.—Shaded precipitous banks of Rio Jiménez, Llanos de Santa Clara, Comarca de Limón, Costa Rica, alt. 650^{ft}, Apr. 1894, J. D. S., no. 5,084.

Baltimore, Md.

EXPLANATION OF PLATE XXVI.—Fig. 1, frond.—Fig. 2, pinnule.—Fig. 3, pinnule of second order.—Fig. 4, ultimate pinnule.—Fig. 5, scale from base of stipe. (Figure 1 is somewhat reduced; the others are variously enlarged.)

PHOEBE AMPLIFOLIA, Mez & Donnell Smith.

NECTANDRA HEYDEANA, Mez & Donnell Smith.

C. E. Faxon, del.

B. Meisel, Lith. Boston

GYMNOGRAMME SCIATRAPHIS Donnell Smith.

A preliminary synopsis of the North American species of Amaranthus.

EDWIN B. ULINE AND WILLIAM L. BRAY.

In selecting work for the present year, our attention was called to the comparatively untried field of North American Amaranthaceæ. The only systematic work since Moquin-Tandon's exhaustive revision of the order was that of Dr. Asa Gray in Proc. Amer. Acad. **5**: 168–9, where he presented a short synopsis of our western Amblogynes, restoring the old generic name of *Amblogyne* Raf., which had been reduced to a section of Amaranthus by Bentham in Fl. Australiensis **5**: 212. Aside from this and an occasional new species by Watson, Torrey and others, we were left to the difficult task of disentangling the vague and conflicting statements of Linnæus and Willdenow, and of setting them right as far as possible with Moquin-Tandon and subsequent writers. Up to the present time our study has been confined to the genus Amaranthus.

Geographically, an attempt has been made to embrace forms from Mexico and the West Indies whenever material and facts were at hand, though they may only meagerly represent the forms that will yet be found in those regions.

For the use of herbarium material, grateful acknowledgments are due to Dr. John M. Coulter, Dr. Wm. Trelease, Dr. N. L. Britton, Mr. F. V. Coville, Dr. B. L. Robinson, Prof. John Macoun, Dr. C. E. Bessey, Mr. John Donnell-Smith, Mr. Walter Deane and Mr. Jared G. Smith. Over 1,000 herbarium sheets of the genus Amaranthus alone were placed at our disposal, substantially comprising the existing material in the larger herbaria of the United States and Canada. With the Missouri Botanical Garden collection came the Bernhardi collection, which has been of inestimable value to us in revealing the European conception of some of the older species. Mr. Hitchcock's West Indian collection and Mr. John Donnell Smith's Central American plants have been especially interesting in pointing out the probable line of travel that many of our introduced species have taken from their original tropical home. The late Dr. Thomas Morong's

collection in the Columbia College Herbarium fairly represents the South American forms.

The characters that are used in the following synopsis to circumscribe sub-groups are by no means absolute, for there is always some shading off and overlapping in one particular or another, which is forever bound to resist every attempt at definite separation. Yet they are natural groups worked out from a common origin, and the group characters herein set forth can only serve to point out these broader lines of differentiation along the path of descent. Likewise many of the species approach dangerously near to one another; and the complex question of adaptation and modification of adventive forms together with the still greater uncertainty which prevails in regard to hybridization among certain groups of species has rendered the question of specific limitation one of peculiar difficulty and uncertainty. This problem still remains unsolved; and only to him who is willing to bestow years of study on the group as it may be seen in nature and under cultivation will there come any great reward. In the meantime much of the vagueness that has heretofore existed must continue to encumber us.

The species may be presented in the following order:—

§ 1. *Sepals 5, abruptly contracted into a narrow claw, more or less united at base, or free.* (AMBLOGYNE.)

This section is as well marked in geographical limits as in flower characters, being restricted with few exceptions to Texas, New Mexico, Arizona, Nevada, southern California and the arid plains of northern Mexico. The characteristic rank weedy nature of the genus is somewhat overcome here by a tendency to color and gracefulness of habit.

* *Plants monœcious.*

\+ *Stamens 2 or 3.*

++ *Utricle indehiscent.*

1. A. BERLANDIERI (Moq.).

Sarratia Berlandieri Moq. DC. Prod. **132:** 268. 1849.

Stem slender, ascending or erect, 15 to 30^{cm} high, branching from base: leaves crowded, deciduous on the older parts of the stem, oblong-obtuse to oblanceolate, 1.5 to 2.5^{cm} long: inflorescence in small clusters, crowded, axillary: flowers darkish, short (2^{mm}): bracts one-third as long as the sepals: stamens two: fruiting sepals 3-nerved, coalescent for one-third their length, not constricted into a tube above: utricle

indehiscent.—Texas, from Austin and Big Springs to the Rio Grande, and northeastern Mexico.

These forms have been known as *A. polygonoides*, but the more leafy smaller habit, more minute glomerules, smaller darker flowers, more spreading membranaceous sepals and uniformly dehiscent utricle clearly justify their separation as a distinct species. Its affinities are much stronger in the direction of *A. urceolatus*, from which it is easily distinguished by the marked difference in sepal venation. Critical comparison of number 2279 of Berlandier, Moquin's type number, with Berlandier 981, 2411 and 859 can leave no possible doubt of their identity with *Sarratia Berlandieri* Moq.

2. A. URCEOLATUS Benth. Bot. Voy. Sulph. 158. 1844.

Amblogyne urceolata Gr. Proc. Am. Acad. **5**: 168. 1861.

Slightly branched: leaves rather small and narrow: sepals of female flower unequal in width, the two exterior with slightly narrowed tri-carinate claw; lacineæ with spatulate or orbicular laminæ, the three interior with strongly narrowed uni-carinate claw, all with entire or slightly crenulate margin with green branching nerves: utricle indehiscent.—The species not reported from North America, but represented by three varieties.

No. 154 Palmer in part from Guaymas, Lower California, is a variety with more branching habit and long lanceolate leaves on very long slender petioles. The more vigorous vegetative character is probably due to growing in gardens.

Var. OBCORDATUS (Gray).

Amblogyne urceolata var. *obcordata* Gr. Proc. Am. Acad. **5**: 169. 1861.

Lamina or dilated summit of sepals strongly notched and nearly obcordate.—Western Texas and New Mexico.

Var. **Jonesii,** n. var.

Plant dwarfed, branching at base, erect, spreading, 7 to 15^{cm} high: stem slender, smooth, purple: leaves scattered, oblanceolate to linear, 1.5 to 2^{cm} long: flowers bright purple: staminate sepals 5: stamens 3: sepals of pistillate flowers abruptly narrowed below, white-margined, with one slightly branched bright purple mid-vein: utricle purple, narrowly oblong, thin indehiscent.—Collected at Bowie, Arizona, in 1884 by Marcus E. Jones.

++ ++ *Utricle dehiscent by a circumscissile line.*

3. A. POLYGONOIDES L. Pl. Jam. Pugill. **2**: 27. 1759.

Amblogyne polygonoides Raf. Fl. Tellur. 42. 1836.
Amarantus polygonoides Hemsley Biol. Cent. Amer. **3**: 14. 1882, in part.

Restricted in range to Florida and West Indies. Stockier and fleshier than its western relative, *A. Berlandieri.* These two forms are probably descendants of a common early tropical species and owe their divergence in part to the difference in route along which they have traveled; one reaching Florida by way of the West Indies, the other coming across the plains of Mexico as far as Texas and New Mexico.

4. A. FIMBRIATUS Benth. Wats. Bot. Calif. **2:** 42. 1880.

Easily known by the broad fimbriate often beautifully colored sepals.—Reported abundantly from southern and eastern California, Nevada and southern Utah, western Texas, Arizona, New Mexico, southward into Mexico and Lower California.

Var. DENTICULATUS (Torr.).

A. venulosus Wats. Proc. Amer. Acad. **17:** 376. 1882.
Sarratia Berlandieri var. *denticulata* Torr. Bot. Mex. Bound. 179. 1858.

This is not diœcious as Watson described it, but agrees with *A. fimbriatus* except that the broadly dilated lamina of the sepals is not fimbriate, but entire or emarginate, and conspicuously marked by branching green veins.

5. A. PRINGLEI Wats. Proc. Amer. Acad. **21:** 476. 1886.

Known from *A. fimbriatus* by the more scattered axillary inflorescence, distinct sepals with green mid-rib, broad scarious margin not fimbriate, longer acute outer sepal and longer spiny bracts.

Probably has much the same range as *A. fimbriatus*, but is not reported from so many stations, nor in so great abundance.

6. A. SQUARRULOSUS (Gray).

Amblogyne squarrulosa Gr. Proc. Am. Acad. **5:** 168. 1861.
Scleropus squarrulosus. Anderss. ined.

A species from the Galapagos Islands, with the broadly ovate or rhombic-ovate lamina of the female sepals all abruptly contracted into a narrow claw, peduncles and pedicels thickened, as in *A. crassipes.* Plant tall and slender, resembling *A. fimbriatus.*

This would at first seem to fall in the Scleropus section by reason of its thickened peduncles and the shape of its sepals; but the incrassate tendency is by no means so strongly marked as in that group, while the tall, slender habit and the abrupt narrowing of the sepals into a slender claw serve easily to distinguish it.

+ + *Stamens five.*

The two following species show a departure from the typical Amblogyne character toward the Euamaranthus group, in flower characters particularly.

7. A. CHIHUAHUENSIS Wats. Proc. Amer. Acad. **21**: 436. 1886.

Leaves ovate-lanceolate to oblong: sepals broadly spatulate, setose-apiculate with green (sometimes branching) mid-vein much thickened at base. Apparently not found in any of the border states.

Collected by Palmer at Hacienda San Miguel, Chihuahua (no. 197), in 1887.

8. **A. Bigelovii,** n. sp.

Monœcious, erect, 4 to 5^{dm} high with abundant slender erect rather short branches: leaves lanceolate, obtuse, 4 to 7^{cm} long, with long slender petiole, much reduced toward the apex of the branches, becoming oblong-elliptical, all prominently mucro-tipped, with prominent veins: inflorescence leafy, axillary, crowded toward the extremity of branch, the stem terminated by a leafy spike: bracts subulate, pungent, slightly exceeding the calyx, 3^{mm} long: staminate flowers with five stamens and five sepals: pistillate flowers with sepals spreading, rather unequal, spatulate-obtuse, the two lateral acute, the one next the bract mucronate-tipped: utricle circumscissile with calyptra very much folded and retracted after dehiscence.—Collected in the Mountains of the Cibola in 1852 by Dr. Bigelow (no. 1,190). Distributed as *Sarratia Berlandieri* Moq.

Var. EMARGINATUS (Torr.).

Sarratia Berlandieri var. *emarginata* Torr. Bot. Mex. Bound. 179. 1859.

Laciniæ of the female calyx widely wedge-shaped, emarginate.—Collected at Camp Green, New Mexico, by Dr. Parry.

* **Plants dioecious.*

+ *Utricle indehiscent: sepals equal.*

9. A. GREGGII Wats. Proc. Amer. Acad. **12**: 274. 1877.

Differs strikingly from both *A. Torreyi* and *A. Palmeri* in habit and in the very short bracts, while the utricle character not only of this but particularly of the following variety is remarkably suggestive of that of *A. pumilus.*—Collected by Dr. Gregg near the mouth of the Rio Grande in 1848.

The fact that but one locality has ever been reported, and that only the pistillate flowers and the upper part of the plant are in existence, places this species on a rather perilous footing.

Var. **Muelleri,** n. var.

Plant more branching: leaves longer, narrower: inflorescence freely branching: sepals spreading, 2^{mm} long, two-thirds as long as the broadly ovate inflated coriaceous utricle: seed larger.—Collected by Mr. Fred Mueller near Vera Cruz in 1853.

It is only for convenience in presentation that these two inseparable forms are permitted to fall with the other dicœcious species, with which their affinities are otherwise very slight. In the utricle characters they display affinities for the Euxolus group, while in habit they are quite anomalous. More material and added knowledge may lead to a very different disposal of them.

10. A. TORREYI Benth. Wats. Bot. Calif. **2:** 42. 1880.

Western plains from Nebraska to Mexico, extending as far west as Nevada. It is the only northern dicœcious form, being replaced in the south-west by the more abundant *A. Palmeri.*

Var. **suffruticosus,** n. var.

Stem woody: leaves narrowly rhombic-ovate, with numerous prominent nerves on the under surface. Distributed as *Amblogyne Torreyi.*—Lower California, Cape St. Lucas (*Xantus* 100 of 1859–60).

11. A. PALMERI Wats. Proc. Amer. Acad. **12:** 274. 1877.

Distinguished by its long terminal spikes and very long rigid pungent bracts.—It is found from western Texas, through central New Mexico and Arizona to the Pacific Coast, but reaches its greatest display in the plateaus of northern Mexico, where it is one of the commonest of plants in gardens, cultivated fields and bottom lands. Very variable.

Var. **glomeratus,** n. var.

Low, decumbent or ascending, branching at base: leaves narrow, very small (not exceeding 1.5^{cm}): fertile flowers aggregated below in large dense glomerules becoming 3 to 5^{cm} in diameter at the base of the plant: sepals more spreading.—Collected in 1889 by Dr. Palmer at Lerdo, Sonora, Mexico (953 ♀, 958 ♂).

A form from Lower California (*Orcutt,* 1884) is taller and stouter and has not the display of pistillate glomerules at base; but in general aspect it presents greater affinities here than for the species.

(*To be concluded.*)

Herbarium Lake Forest University, Lake Forest, Ill.

Notes on our Hepaticæ. II.

The genus Riccia.[1]

LUCIEN M. UNDERWOOD.

The main purpose of these notes, made in reviewing the material that has been accumulating in my herbarium for the last few years, is to call the attention of local collectors to these much neglected and inconspicuous plants in order to learn more definitely their distribution. We still know almost nothing of the distribution of most of the American species, certain forms being known only from widely separated stations with no information from the intermediate territory. There is a strong probability that many species will yet be found especially in lowlands of the southern Atlantic states, in the Gulf states, and on the Pacific coast where the climatic conditions more nearly approach the Mediterranean region of the old world, where the genus is well developed.

The genus as now limited excludes the various forms of *R. fluitans* and *R. natans* which will form genera by themselves.

RICCIA FROSTII Aust. is probably widely distributed from the Rocky mountain region eastward to Illinois and Ohio. The specimens distributed as *Riccia crystallina* in Hepaticæ Americanæ, no. 63, are of this species. *R. Watsoni* Aust. founded on male plants is doubtless the same species, as originally suggested by its author. The only specimens purporting to be of this species that I have seen are in Herb. James from Wolf and Rothrock's collections on the Wheeler Survey; these are fertile and conform to the type of *R. Frostii*. Specimens from the eastern portion of the range are more robust than the mountain forms but the spore characters are similar; they may be characterized as follows:

RICCIA FROSTII **major,** n. var.—Thallus much larger than in the type, 3–4 times dichotomously branched, irregularly spreading and somewhat imbricate, the divisions wider, commonly tinted with purple at the margins.—Banks of Missouri River, St. Charles, Mo. (*Demetrio*, no. 5); Manhattan, Kansas (*Kellerman*); sterile forms are also at hand from Illinois (*Wolf*).

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[1]No. I of this series is in this journal **14:** 191–198. 1888.

R. ALBIDA Sulliv. is known only by two plants. The type was collected by Wright in Texas in 1845 and is in the Sullivant collection. I have received a single plant from Langlois, collected in Louisiana. Both plants are lacking in fruit. The plant is allied to *R. glauca* in its vegetative characters but its spores are a desideratum in order to understand its affinities.

R. LAMELLOSA Raddi as represented in Austin's Hepaticæ Bor.-Am. no. 140 has spores quite unlike those figured in Lindenberg (Monog. Ricc. *t.30*), lacking the hyaline margin. It may prove to be an undescribed species, but until Raddi's type, if in existence, can be seen it will be desirable to let it rest in its present position. The spores in this specimen are very characteristic, being 84–94μ in diameter, clearly and regularly but not strongly reticulated over the rounded surface. Austin's plants were from Closter, N. J.; the same plant has been sent from Mobile, Ala., by Dr. Mohr.

R. ARVENSIS, var. HIRTA Aust. is apparently a very distinct species differing widely from *R. arvensis* in the densely ciliate margins of the thallus and especially in the larger spores (92–108μ) which are nearly black and consequently almost opaque and very indistinctly reticulate. It was issued by Austin (Hep. Bor.-Am. no. 142) but the specimens in the set in my herbarium are sterile; Austin has described the spores in his MSS. now in my possession, which is important since they were omitted in the original description. Specimens sent me in 1884 by Parish from San Bernardino, other material collected by Bolander, and especially the fine material furnished by Dr. Campbell for our exsiccatæ (Hepat. Amer. no. 138) have enabled me to separate and distinguish this very distinct and elegant species, which will take the name **Riccia hirta** Aust. (1869, as synonym.)

R. CALIFORNICA Aust. was very imperfectly described and the type is inaccessible if in existence. I have referred to this species some sterile fragments from the California Academy of Science, and fragmentary fertile specimens collected near Berkeley by M. A. Howe, which closely agree with the brief description. The light brown spores with faint reticulations with very small areolæ (12–14 measuring the convex surface of the spore) are quite characteristic of these specimens. More material is needed to trace the full character of the species and the same is true of its congeners *R. tumida*

Lindenb. (known only from the very imperfect specimens distributed in Austin's Hepat. Bor.-Am.) and *R. ciliata* which is known from this country only through the report of Austin, there being, so far as I know, no specimens at hand.

R. CRYSTALLINA L.—The figures of this species in Lindenberg's Monograph do not fairly represent the species as it appears in various European exsiccatæ nor do they conform to the usual description. Misled by this inaccurate representation we issued plants under this name that are quite readily distinguished from *R. crystallina* now that suitable material is at hand for comparison. There is some resemblance between *R. crystallina* and *R. Frostii* in the method of dissemination of spores but they are distinguished by their thallus characters.

The following undescribed species have been sent in from southern and lower California:

Riccia aggregata, n. sp.—Thallus 1–3 dichotomous, forming more or less radiately divided crowded masses 1–2^{cm} or more in diameter; divisions of the thallus narrow (1–1.5^{mm}), solid, papillose-reticulate and green above, purplish beneath and provided with purplish scales not exceeding the margin of the thallus which is somewhat membranous; capsules rather prominent, with a purple spot in the thallus just above; spores 70–78μ in diameter, nearly black, finely reticulate but almost opaque, scarcely margined.

On the ground, Pasadena, California, March 1893. (*A. J. McClatchie*, no. 24.)

Riccia Catalinæ, n. sp.—Thallus thin, loosely attached to the soil, 3–4^{cm} in diameter, stellately or radiately 3–6 dichotomous; divisions of the thallus broad (2–3^{mm}), more or less reticulate-spongy above, the apices more or less expanded and emarginate, naked beneath and at the margins; capsules large, in one or two rows; spores 86–95μ in diameter, very dark brown, nearly opaque, with very large obscure reticulations which often contain a free ridge-like crest, bordered with a more or less minutely crested margin.

Wet soil in a cañon, Santa Catalina Island, California, September, 1893. (*McClatchie*, no. 441.)

Riccia Brandegei, n. sp.—Thallus orbicular, 2–4^{cm} in diameter, stellately many times divided, closely attached to the soil; divisions of the thallus narrow (1–1.5^{mm}), spongy-cellular,

the surface broken with deep irregular pits, yellowish green or reddish, especially at the margins, the ultimate divisions much crowded and often overlapping, naked at the margins and underneath; capsules deeply imbedded in the spongy thallus, not apparent above but the spores ultimately break through the upper side of the thallus; spores 90–127μ in diameter, black, opaque, slightly reticulate-rugose, with a narrow margin which gradually disappears with age.

Lower California, 1892. *(T. S. Brandegee.)*

The species north of Mexico may be separated by the following table in which spore characters, hitherto not recorded, are utilized in separating species, although wherever possible the characters of the thallus have been employed in order to make possible the discrimination of material in the sterile condition. *Riccia bifida* and *R. Beyrichiana* are omitted as there is no recent evidence that they are members of our flora.

Thallus with large air cavities which communicate with the upper surface. (SPONGODES Nees.)

Upper surface of thallus spongy, pitted, green or tinged with purple . . . . . *R. crystallina* L.
Upper surface of the thallus mostly smooth except for the median groove; divisions long, yellowish green . . . . *R. lutescens* Schw.

Thallus solid, mostly without air cavities. (LICHENODES Bischoff.)

a. Thallus without scales or cilia on the margins or underneath.

i. Spores medium size or small (at least under 100μ).

1. Thallus only slightly reticulate above or not at all.

* Spores small (60μ or less).

Thallus with wide divisions, thin and flat; spores muricate-spinulose . . . . . *R. tenuis* Aust.
Thallus with narrow divisions.
Spores obscurely muriculate . . . . . *R. Frostii* Aust.
Spores coarsely reticulate . . . . . *R. Huebeneriana* Lindenb.

* * Spores larger (75–95μ).

Divisions of the thallus broad; spores nearly opaque, with large reticulations . . . . . *R. Catalinæ* Underw.
Divisions of the thallus narrower; spores dark fuscous with deep reticulations (about 8 across convex surface). . *R. arvensis* Aust.

2. Thallus glaucous or white, clearly reticulate-papillose.

Spores brown, 65–80μ, reticulate . . . . . *R. glauca* L.
Spores unknown: thallus milk white above . . . . *R. albida* Sulliv.

ii. Spores very large (130–170μ) black, opaque.

Thallus very large, 4–7^{mm} wide . . . . . *R. Donnelli* Aust.

b. Thallus scaly underneath, not ciliate.

i. Scales and usually the thallus purple underneath.

Thallus simple or forked: spores light brown anastomose-reticulate . . . . . *R. nigrella* DC.
Thallus 1–3 dichotomous; spores nearly black, finely reticulate, almost opaque . . . . . *R. aggregata* Underw.

ii. Scales usually whitish; thallus green underneath.

Spores light brown, 84–94μ; scales reaching beyond the margin.
R. lamellosa Raddi.
Spores dark brown, 64–70μ; scales not reaching the margin.
R. minima L.

c. Thallus ciliate at the margins or apices.

i. Spores black or nearly so.

Thallus small; spores (about 85μ) reticulate with 10–12 areolæ across the surface . . . . . *R. ciliata* Hoffm.
Thallus larger; spores 92–108μ; opaque, scarcely reticulate.
R. hirta Aust.

ii. Spores brown.

Thallus simple or bifurcately lobed, spores 84–92μ.
R. tumida Lindenb.
Thallus stellate or fan-shaped, forming rosettes.
Spores 68–73μ; faintly reticulate with 12–14 areolæ across the convex surface . . . . . *R. Californica* Aust.
Spores 85–110μ, reticulate with 7–8 areolæ across the convex surface . . . . . *R. Lescuriana* Aust.

The following geographic distribution shows rather the paucity of our information than the real limits of the range of most of the species. Six species are known only from California, viz.: *RR. aggregata, Californica, Catalinæ, ciliata, glauca and tumida.*

R. Donnellii is known only from Florida.

R. albida is known from Texas and Louisiana; *R. hirta* from New Jersey and California.

R. nigrella is known from California, New York and Pennsylvania; *R. Hubeneriana* from Massachusetts, New Jersey and Ohio; *R. Lescuriana* from New Jersey, Florida and Illinois.

R. lamellosa is known from Ontario, New Jersey, Alabama and California.

R. arvensis from Connecticut, New Jersey, Ontario and District of Columbia; *R. crystallina* from Illinois, South Carolina, Colorado, and Nevada.

R. minima is known from New York, New Jersey, South Carolina, Illinois and California, *R. tenuis* from New Jersey, Delaware, Ohio, Missouri and Arkansas.

R. Frostii is known from Ohio, Illinois, Missouri, Kansas, S. Dakota, Idaho, Montana, and Colorado.

R. lutescens leads the list, being known from Massachusetts, New York, Virginia, Tennessee, Louisiana, Ontario, Ohio, Illinois, Minnesota and Idaho.

From 21 states there are no Riccias reported and fourteen others have reported each a single species.[2]

The above showing would strongly point to the fact that there is need of much local observation before we can form any rational idea either of the extent of the genus as developed in America or of its geographic distribution.

Greencastle, Indiana.

[2] *Ricciocarpus natans* and *Ricciella fluitans* formerly included in this genus have a much more extended distribution.

Pleodorina, a new genus of the Volvocineæ.[1]

WALTER R. SHAW.

WITH PLATE XXVII.

In September, 1893, the writer collected at Palo Alto, California, a Volvox-like alga, which Dr. D. H. Campbell at once suggested was different from any described genus. Subsequent review of available literature on the subject at Stanford University and by Dr. W. G. Farlow and Mr. B. M. Davis at Harvard University, brings to light no mention of a similar form. The plant is a so-called "cœnobium" of about 128 biciliate cells, one-half to two-thirds of which are, in the non-sexual form observed, "parthenogonidia." In view of its apparent affinity with *Pandorina* and *Eudorina*, the larger number of cells, and the differentiation of the cells into two kinds, the name *Pleodorina* seemed appropriate and was adopted.

The first specimens were collected Sept. 19, 1893, in an irrigation ditch at Palo Alto, and others were taken from the same place at intervals of a few days for about two weeks. They were kept in a wide bell-jar until Oct. 13th, when they suddenly disappeared before a swarm of insect larvæ. The living specimens from which drawings were made were held in place under the microscope by allowing the cover-glass to press upon them slightly. An attempt was made to determine the time required for the full development of the gonidium-bearing individual from the gonidium by isolating mature plants in watch glasses; but the daughter plants were not healthy, and did not come to maturity.

The typical specimens are those in which the gonidia have reached their full size previous to division. Such individuals are spherical (fig. 1) or more often ellipsoidal, and measure 187–258μ in long diameter;[2] the short diameters of ellipsoidal specimens measure 7–20μ less. With one exception the number of cells in those counted varied from ninety-eight to one hundred and twenty-six; the exception numbered sixty-three

[1] Prepared under the direction of Dr. Douglas Houghton Campbell.

[2] Most of the measurements and also the counts of the cells given here are taken from specimens permanently mounted in 25% glycerine after fixing and staining.

cells. The cells are situated in the periphery of the sphere, of which the gonidia occupy a hemisphere or more and the vegetative cells the remainder. The centers of the two areas thus distinguished coincide with the ends of the long diameter in ellipsoidal specimens. The vegetative cells are about 12μ in diameter, and the gonidia just before division 25–30μ. Each vegetative cell (in young individuals the cells are all alike) is oval, with the smaller, clearer end directed outward and bearing two cilia which project through the gelatinous envelope. In each cell a pyrenoid and a red pigment corpuscle are conspicuous, the latter situated on the surface near the forward or outer end (figs. 5 and 7). The pyrenoid is in the inner end of the cell and appears to lie within the center of the single chromatophore, the edges of which extend forward around the periphery of the cell. Specimens fixed with 1% chromic acid, washed, stained with hæmatoxylin and afterward with alum cochineal, show in each cell a centrally located nucleus with a well defined nucleolus (figs. 7 and 8). Some young specimens fixed with picro-nigrosin show a vacuole in the hyaline forward end of the cell.

A number of specimens were fixed and stained with a view to ascertaining whether any protoplasmic connection exists between the cells. After fixing on the slide with 1% chromic acid, some were stained with safranin, Bismark brown, alum cochineal and haematoxylin. Others were fixed and stained with picro-nigrosin, but in no case did any connecting threads appear. At the time when these observations were being made, the writer met with a specimen of *Volvox minor* Stein, and here the connecting threads between the cells were visible in the living plant under a magnification of only 57 diameters and without the use of any stain. In the young of *Pleodorina* the cells are all of the same size and apparently alike, but in the older ones the gonidial cells become gradually larger, and then more spherical and finally even slightly flattened. The granular cell-contents increase; the pyrenoids increase in number, and the red pigment corpuscle becomes less conspicuous and disappears.

The movement of the plant in the water was followed in the case of a few individuals bearing well developed gonidia. In swimming through the water the vegetative pole is directed forward and the plant revolves to the right (in observed cases) on the axis connecting the vegetative and reproductive poles.

The path is parallel to this axis in upward vertical as well as in horizontal movement.

The division of the gonidia was followed in a number of cases on different days. The first cell division took place about two hours after noon and the daughters escaped from the mother plant eighteen to twenty-four hours afterward. Previous to division the investing membrane of the cell begins to swell up and withdraw from the protoplasm, doing so at first in a zone just back of the point of attachment. This for a time gives the forward end of the cell the form of a beak (fig. 6). The two cilia persist on the gonidium and are active even after the cell has divided several times. The succession of divisions is essentially as in *Eudorina elegans.*[3] The first two divisions are perpendicular to the surface of the whole sphere and to each other (fig. 2, *a–c*). Before the next division takes place the walls already formed become curved and oblique, so that seen from the front the cells overlap slightly (fig. 3, *d*). The next division is anticlinal and somewhat oblique (figs. 2, *d* and 4, *b*). As the division proceeds a plate of cells is formed which becomes concave from the front (fig. 4, *c*); the concavity increases until the plate becomes bowl shaped, and the mouth of the bowl closes to form a hollow sphere of very closely arranged cells before the last division takes place.[4] The cells separate slightly and become rounded; then the last division into about 128 cells occurs and the cells are again closer and flattened by contact. Finally the cells become gradually more and more separated from each other, though fixed in the common envelope.

After the last division takes place the cilia begin to form as outgrowths, two from the outer end of each cell. Thus it is to be borne in mind that the cilia do not arise on that end of each cell which corresponds to the ciliated end of the mother gonidium, but on the opposite end. As the cilia become longer they acquire movement and each daughter plant rotates slowly within the swelled up membrane of the gonidium from which it has developed. The daughter plants escape as spheres of cells which are all alike. One case was observed in which the formation of the cilia began before the young plants had reached the spherical stage. This was in the above mentioned sixty-three-celled plant. In this in-

[3] Goebel, Outlines of Class. and Sp. Morph. of Plants (Eng. Trans.) 37. 1887.

[4] Beyond this point the transition was not actually followed but traced by different stages present in each of two fixed mother plants.

stance the daughter plants, 39 in number, consisted of about 64 cells each (maximum estimate). Usually one or two of the gonidia fail to undergo division, and occasionally there are one or more cells in the reproductive area which do not even increase in size.

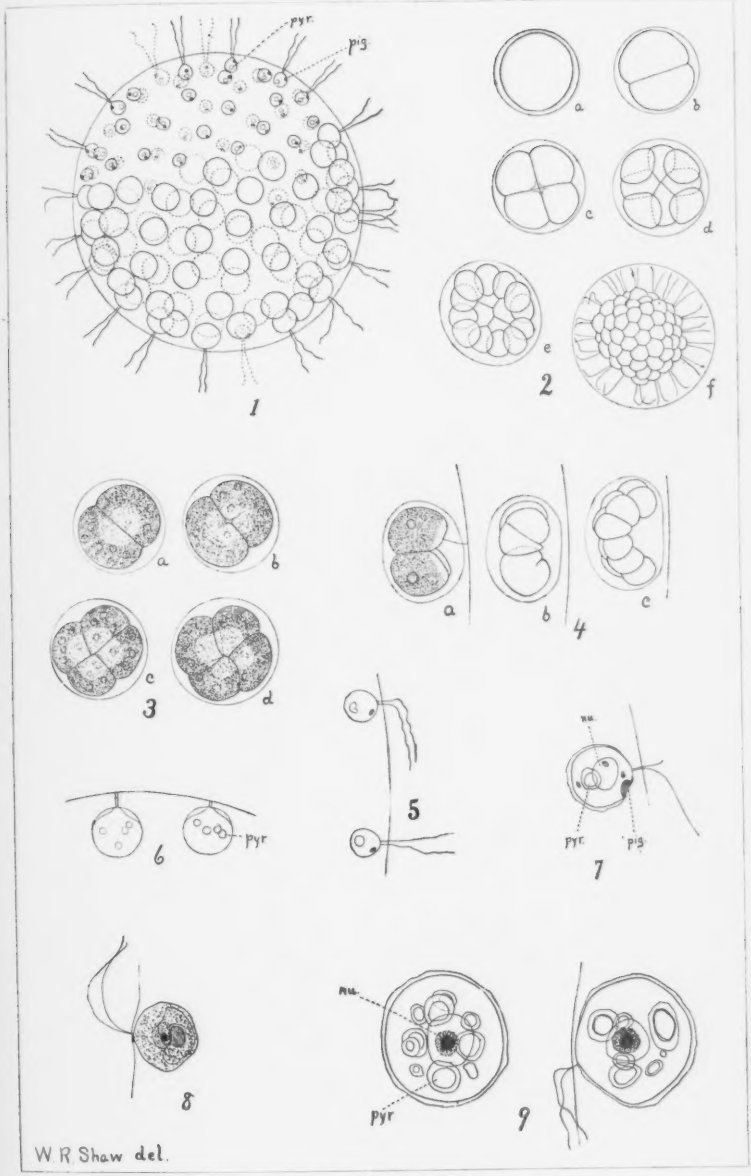
In comparing this plant with others of similar type it is reasonable to suppose that there is a sexual generation yet to be observed.[5] If we consider that *Gonium*, *Pandorina*, *Eudorina*, and *Volvox* represent a near approach to a true line of ascent, we have then in *Pleodorina*, so far as we can judge with no knowledge of its sexual generation, a new member of the series intermediate between the latter two, but much nearer to *Eudorina*. Its close affinity to *Eudorina* is indicated by the absence of any discernible protoplasmic connection between the cells as well as by the mode of development of the individual from ciliated gonidia. It resembles *Volvox* more than *Eudorina* does in the number of cells composing the individual and the specialization of certain cells for the purpose of reproduction. Thus we may expect in the sexual generation a degree of differentiation which shall be a step higher than that of *Eudorina* and nearer to the latter than to that of *Volvox*.

With our present knowledge we may briefly describe the subject of these notes as follows:

PLEODORINA, gen. nov.—Plant body a hollow, spherical or spheroidal "cœnobium" of green biciliate cells fixed in a hyaline gelatinous envelope. Red pigment spot in each cell. No connecting filaments between the cells. Non-sexual reproduction by gonidia; gonidia formed by increase in size of part of the cells; daughters escape from mother plant as spheres of similar biciliate cells. Sexual reproduction not known.

P. Californica, sp. nov.—Number of cells composing the plant body approaching 64 or 128; usually about 120. Plant body about 175–300μ maximum diameter. Cells oval; smaller end hyaline and bearing two cilia which project through the envelope; each cell containing a red pigment spot, nucleus, chromatophore, and pyrenoid. Vegetative cells about 12μ in diameter; cilia several times as long as cells. Non-

[5] Up to date of present writing, April 7, 1894, no more of the plants have been collected.



SHAW on PLEODORINA.

sexual reproduction by development of one-half to two-thirds (50–62%) of the cells into gonidia which retain cilia until ready to divide or longer. Diameter of gonidia 2–3 times that of vegetative cells. Each daughter plant enclosed within the swelled membrane of its mother gonidium until it becomes independent; active before escaping; all cells alike at time of escape. Sexual reproduction not known.

Habitat: Fresh water ditch, Palo Alto, California. Autumn. *Stanford University, California.*

EXPLANATION OF PLATE XXVII.

Fig. 1. Typical plant of 120 cells; from life; cilia diagrammatic and added afterward from fixed specimen; × 178.—Fig. 2. Successive stages of division of gonidium, front view; *a*, 2:50 P. M.; *b*, 3:20 P. M.; *c*, 4:15 P. M.; *d*, 5:05 P. M.; *e*, 5:40 P. M.; *f*, 10:15 following morning; cilia here also diagrammatic; × 337.—Fig. 3. Another gonidium from same mother plant; lighter central area indicates hyaline portion of cell; *d* shows obliquity of dividing walls; *a*, 2:45 P. M.; *b*, 3:25 P. M.; *c*, 3:40 P. M.; *d*, 4:50 P. M.; × 337.—Fig. 4. Side view of another gonidium from same mother plant; *a* shows only one of two cilia which were present in full size and active; *a*, 2:20 P. M.; *b*, 3:15 P. M.; *c*, 4:35 P. M.; × 337.—Fig. 5. Two vegetative cells from same plant to show relative size; cilia as in fig. 1; × 337.—Fig. 6. Two gonidia just previous to division, × 337.—Fig. 7. Vegetative cell showing pigment corpuscle; chromic acid 1%, and safranin; permanent mount in glycerine; × 1,000.—Fig. 8. Vegetative cell showing chromatophore surrounding pyrenoid; chromic acid 1%, and hæmatoxylin, afterward stained with alum-cochineal; permanent mount in glycerine; × 1,000.—Fig. 9. Two gonidia showing nucleus and pyrenoids in each cell; same specimen as fig. 8; × 1,000.

All drawings sketched with an Abbé camera; *pyr.* = pyrenoid; *nu.* = nucleus; *pig.* = pigment spot.

Noteworthy anatomical and physiological researches.

The fixation of free nitrogen by plants.

A review of the question of the assimilation of free nitrogen must of necessity be somewhat disconnected as different investigators approach the subject from such different standpoints, some dealing entirely with the economic phase while others treat its biological aspect.

The present synopsis deals mainly with the literature of the year 1893, including only those papers of the previous year that throw light upon concluding investigations.

Research on this question has not been as active during the past year as in preceding years, and in a number of cases papers are only concluding pieces of work undertaken earlier. The general trend of the whole subject, broadly considered, has been much more in the line of general physiological experiment than in the morphological study of the agent of nitrogen fixation.

Assimilation by non-leguminous plant organisms.

Concerning the question as to what organisms are able to utilize uncombined nitrogen, several papers have appeared.

Frank's contribution to the subject in showing that some of the algæ possess this ability seems now to be settled beyond dispute. Schlœsing and Laurent [1] experimented upon this question, using both the direct and indirect methods of nitrogen determination and found that not only were the green algæ able to fix gaseous nitrogen but that some of the mosses possessed this peculiarity in a marked degree. Koch and Kossowitsch [2] have repeated this work with green and blue green algæ, using purely inorganic solutions and have arrived at the same conclusion. While the number of experiments upon this point seem to show conclusively that the lower green forms of vegetable life possess this power, yet it would seem desirable if experiments were also carried out with pure cultures of various forms and thus thoroughly exclude all possible chance for misinterpretation of results. [3]

[1] Ann. Inst. Past. **6**: 110. 1892.–Comptes rendus Acad. **115**: 732. 1892.
[2] Bot. Ztg. **51**: 342. 1893.
[3] Some of Schlœsing and Laurent's experiments were carried out on approximately pure species but they were not grown in sterilized culture media.

The importance of algal assimilation, for so long a time overlooked, is by no means inconsiderable, for it doubtless will enable one to harmonize many results that heretofore seemed inexplicable. Particularly is this true with experiments carried on in natural soils with non-leguminous phanerogams, where the nitrogen claimed to be assimilated is always relatively small.[4]

In regard to chlorophylless organisms, Berthelot[5] has recently studied several soil bacteria in pure culture, *Aspergillus niger*, *Altenaria tenuis*, and a Gymnoascus, using for a culture medium, humic acid and kaolin. With these forms he was able to detect a marked increase in the nitrogen content. The bateria of lupine tubercles grown in humic acid and Cohn's solution increased the amount of fixed nitrogen by fifty per cent. He also noted that when the amount of combined nitrogen becomes large, the organisms utilize this rather than continue to fix the elemental gas.

Winogradsky[6] has issued a preliminary paper upon the ability of bacteria to function as nitrogen collectors. He worked under bacteriological conditions, using for a culture medium a non-nitrogenous but fermentable solution (pure dextrin and specially prepared mineral salts). With this medium, he isolated one well characterized bacillus able to form gas and produce butyric acid in quantities. It would grow neither on gelatin nor on gelatinized silica to which sugar had been added. In general, it bore a strong resemblance to Fitz's *B. butylicus*.

While the evidence at hand as to the ability of lower organisms to utilize atmospheric nitrogen seems to be fairly complete, it is not so definitely settled whether the same is true for higher plants, excluding of course the legumes. Frank has persistently maintained the view that the ability of fixing nitrogen was a function of protoplasm and was resident in the higher plants as well as the simpler. Especially is this marked, he claims, in thrifty, vigorous plants in the growth subsequent to the seedling stage. He has found, repeatedly, a marked increase in the nitrogen content of soil and crop where non-leguminous plants such as rape, oats and

[4] Note in this connection the results of Schlœsing and Laurent, Ann. Past. **6**: 110, in which a fixation of N was observed with oats, cress and mustard, where algal vegetation flourished, but where this was excluded no gain could be detected.

[5] Comptes rendus Acad. **116**: 842. 1893.

[6] Comptes rendus Acad. **116**: 1385. 1893.

mustard were used. In his last paper,[7] he brings together the results of several experiments made during the last few years, in which is shown a gain in N, both in crop and soil, over what was in the seeds and soil at the beginning. Frank's methods are not given in sufficient detail to enable one to judge of his results critically; in fact this charge has been made repeatedly against many of his observations.[8] He uses mainly the indirect method of nitrogen determination, planting the seeds in a soil containing a known quantity of fixed nitrogen and then determines by analysis the content of the soil and crop. If the sum at the end exceeds the total amount available at the beginning, he reasons that the plant has assimilated gaseous nitrogen. A control pot with unplanted soil is usually analyzed to see if there is any change in the fixed nitrogen of bare soil. As his experiments are usually carried out on unsterilized soil and his unplanted check soils often show a gain in fixed nitrogen, there is hardly any doubt that the N-increase in his experiments with non-leguminous plants is in part due to fixation by lower organisms, algæ, fungi, or bacteria that are common to the soil.

Kreusler[9] points out a serious objection to his methods of analysis as not sufficiently accurate to discriminate in the case of non-leguminous plants where such small increments are to be noted.

In the résumé above referred to two experiments with non-leguminous phanerogams are given which were made in absolutely N-free land, the results of which are as follows:

Sinapis alba (4 plants): grams of N in seed, 0.0012; in crop, 0.0043.
Solanum tuberosum (4 pieces): grams of N in seed, 0.022; in crop, 0.2186.

He also describes a still more recent experiment, made with *Sinapis alba*. In this case he used large bell jars and although the plants did not develop normally (they were unable to unfold their flower buds in this closed space), he found a certain amount of nitrogen fixed.

The N content at beginning was as follows:

Three seeds, 0.0009^{gm}; soil, 0.162%;

at close of experiment,

Crop, 0.0507^{gm}; soil of pot, 0.215%; soil of control, 0.195%.

[7] Bot. Ztg. **51**: 150. 1893.
[8] Journ. f. Landw. **41**: 144. 1893.
[9] Bied. Cent. **21**: 257.

Frank claims that the results reported by Liebscher[10] with mustard are in general confirmatory of his experiments. This latter investigator worked under field conditions and claims that upon rich soil white mustard can collect twice as much nitrogen as thrifty peas, beans or clover. Liebscher's paper is very full and explicit as to methods and details but his experiments were conducted under such conditions that the different factors were not controlled, hence the value of the conclusions is much lessened. He concludes that the ability of collecting nitrogen is present with certain non-leguminous plants (mustard and oats) but only when they are growing under optimum conditions. In rich unsterilized soil, peas do not increase in thriftiness even if they are fed with combined nitrogen, while the non-leguminous plants are much benefited by such a treatment.

Liebscher thinks that errors of analysis will hardly explain the quantity of nitrogen apparently collected by the oats and mustard but as he admits, no control was exercised over the rainfall or the water used for watering, neither was the influence of algæ or soil organisms taken into consideration.

It would seem that while there may be an increase in the nitrogen under field conditions that may possibly possess some economic value, yet from the standpoint of physiology, these experiments are not sufficiently conclusive to prove that the higher plants themselves were able to fix the nitrogen.

Lotsy[11] has recently studied this question relative to the mustard assimilation in a careful way, employing both sand and water cultures in sterile and unsterilized condition, and from his work concludes that neither *S. alba* nor *S. nigra* are able to live without combined nitrogen. In this connection it is only necessary to refer to the exceedingly careful researches made previous to this by Schlœsing (fils) and Laurent[12] in which they showed by a comparative set of experiments, by both direct and indirect methods of analysis, that white mustard, oats, cress, and spergula were unable to assimilate free nitrogen.

In 1890 Petermann[13] affirmed that barley was as efficient a nitrogen collector as beans. Since then he has published a second paper[14] giving full details of his experiments. His

[10] Journ. f. Landw. **41**: 180. 1893.
[11] Bull. O. E. S. Dept. of Agriculture *18*.
[12] Ann. Inst. Past. **6**: 114. 1892.
[13] Mém. Acad. roy. de Belg. **44**: 1889.
[14] Mém. Acad. roy. de Belg. **47**: 1892.–Abs. in Chem. Cent. **2**: 988. 1893.

plants were grown in natural soil, under normal atmospheric conditions, and also in air freed from combined nitrogen. His results showed a marked gain with barley in normal air, and somewhat less increase in air freed from fixed nitrogen. The N-content of seed, water added, drainage water, and crop were carefully determined but as he himself says, the factor of unsterilized soil does not exclude the possibility that lower organisms may have functioned in the capacity of nitrogen collectors. He has since repeated his experiments,[15] using both natural and sterilized soils, and arrives at a different conclusion. In unsterilized unplanted controls, having, however, evident algal growth, a slight gain was noted. In sterilized unplanted soil and soil sown to barley a slight reduction was found. This corroborates Schlœsing's results and shows that the increase sometimes ascribed to arable land is really due to its living organisms. Unfortunately, the experiment in unsterilized soil planted to barley was lost, but the fact that the sterilized soil planted with barley lost a part of its N shows that the supposed gain in the previous series was really due to soil organisms of a lower type.

In Frank's last paper,[16] already referred to, he presents his views in a compact and well digested form, citing experiments of his own, some of which are detailed for the first time, and critically reviewing the work of other investigators. He regards the experiments carried on in closed glass spaces as unnatural inasmuch as the conditions are so abnormal that the plant is unable to fruit. As he claims that the nitrogen assimilation of non-leguminous plants can only take place when the plant is thrifty and vigorous, this objection seems well founded. As conditions more nearly approaching those of the open air necessarily embrace influences that must be considered, it would seem that the only way to settle this question is to carry out simultaneous experiments under various conditions by both direct and indirect methods and then correlate the results.

Frank summarizes his results as follows:

1. The legumes can assimilate free N without the intervention of the symbiotic organism.

The strongest case he cites to prove this is the experiment made with four plants of *Robinia pseudacacia* in N-free steril-

[15] Bull. Acad. roy. de Belg. **25**: 267–276. 1893.
[16] Bot. Ztg. **51**: 139. 1893.

ized sand, in which an increase in nitrogen from 0.0024[gm] to 0.0538[gm] is noted. This experiment he regards as fatal to the theory of Hellriegel, inasmuch as this legume without tubercles on its roots can materially increase its nitrogen supply.

2. The symbiotic microbe isolated from a leguminous plant thrives luxuriantly on organic N but barely lives when it derives its N from the air.

In this view he is opposed more or less strongly by Prazmowski,[17] Laurent,[18] Beyerinck,[19] and Bertholot,[20] all of whom maintain that pure cultures of the tubercle organisms take up quantities of uncombined nitrogen.

3. The quantity of combined N in root tubercles does not suffice to account for the N in remaining plant organs.

He takes the analyses of five plants of *Lupinus luteus* and determines the N-content of the tubercles, the aerial organs and the roots proper and shows that at no time during the development of the plant do the tubercles contain more than a fraction of the nitrogen that is present in the plant. Unless the tubercles yield up a continuous supply of N, which has never been claimed as taking place, it is hardly possible to account for the N supply of the plant unless the plant itself takes part in the assimilatory process. As the samples selected were taken from an open field, the conditions are such that the conclusion is hardly warranted that the plant itself assimilated a large part of the nitrogen. Frank's own experiment with this same plant in sterilized soil (sand) only showed with six plants an increase from 0.042[gm] in seed to 0.3475[gm] N in crop, so that the factor of soil and its organisms seems to be more important than anything else even in his own experiments.

4. The non-leguminous vegetable organisms can assimilate free nitrogen.

To show how wide spread is this function, he classifies examples under the following heads, including:

(*a*) fungi, quoting as an example a ten months' culture of *Penicillium cladosporioides* in a nitrogen-free sugar solution as fixing 0.0035[gm] of N;

(*b*) algæ and mosses;

(*c*) phanerogams;

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[17] Landw. Versuchst. **38**: 5. 1891.
[18] Ann. Inst. Past. **5**: 135. 1891.
[19] Bot. Cent. **52**: 137. 1892.
[20] Comptes rendus Acad. **116**: 842. 1893.

citing a résumé of the experiments he has made with different plants. He also quotes confirmatory evidence from Liebscher and Petermann that may now be disregarded or at least considered of very doubtful value.

5. How far is combined N (nitrate), if used as a manure, utilized by the plant and what becomes of it in the soil?

Frank holds that this subsidiary question should also be considered in a discussion of the nitrogen question. Most agriculturists affirm that if plants are fed with increasing amounts of nitrates a corresponding increase in N will be found in the crop. Frank planted mustard in N-free soil to which definite amounts of $Ca(NO_3)_2$ were added.

The seed contained .0003^{gm} and the soil .061^{gm} in the form of the salt, while the crop showed .051^{gm} N and no trace was found in the soil. An unplanted check soil containing .061^{gm} at the same time contained only .0046^{gm} N, thus showing that there is a large loss that is of no use to the plant.

Repeating a part of the experiment with unplanted soil pots to which a definite amount of the nitrate had been added, a large portion of the nitrogen was found to have disappeared. This disappearance he thinks is due to activity of micro-organisms of the denitrifying type as shown by Breal,[21] Schlœsing and others, but it shows that the increased amounts of N furnished in a manure may not reappear in the crop. They serve to make the plant more thrifty in the beginning and thus increase its ability to utilize free nitrogen. For this reason it is necessary to furnish combined nitrogen to non-leguminous plants during the germinating period while the legumes on the other hand can forego fixed nitrogen from the first, owing partly to their highly albuminous seeds and partly to the symbiotic relations that they maintain with the tubercle organism by means of which the assimilatory activity of the plant is largely increased.

The actual fixation of nitrogen by legume tubercles.

Concerning the ability of legumes to acquire free nitrogen there is no diversity of opinion, but just how these plants fix this gaseous element is not so definitely known. The generally accepted idea that the process bears an intimate relation to the presence of root nodules is no doubt correct in the main, but whether the nitrogen is fixed by the nodule organ-

[21] Comptes rendus Acad. 114: 681. 1892.

ism or the plant itself or is a partnership act is by no means settled.

The most important contributions to this phase of the question that have appeared in the past year are the joint papers of Nobbe and Hiltner.[22] In their several papers, covering experiments since 1890, they show concordant results. They hold that the assimilation of nitrogen by legumes bears a direct relation to the formation of bacteroids. In numerous cases they found that plants (peas) growing in good soil and well supplied with nodules were unable to make much gain. When inoculated with pure cultures of *B. radicicola*, some plants would gain largely in nitrogen while others would apparently suffer from nitrogen hunger. When the tubercles on these plants were carefully examined they noted that the nodule-producing organisms were unchanged in those plants that hungered for nitrogen, while in the thriftier ones, the bacteria were changed into bacteroids. They conclude that (1) tubercles in which bacteroid formation does not occur are injurious instead of beneficial to the host plant, (the unchanged bacteria are then merely parasites); (2) the unchanged bacteria present in tubercles seem to have no relation to the nitrogen fixation by legumes; (3) the more vigorous the bacteria the less tendency there is toward bacteroid formation; (4) the assimilation of N begins with the formation of bacteroids.

In some experiments with Robinia they obtained striking results. The plants gained more nitrogen in the end when cultivated in nitrogen-free soil than in soil containing nitrogen. This was because there was a more complete conversion of the bacteria into bacteroids in non-nitrogenous soil than where nitrates were present. Manuring with nitrates causes a more rapid development of the plants at first, and with this a more rapid growth of smaller nodules, but these were of less benefit than the larger nodules noted in nitrogen-free soil, the bacteria of which were entirely changed into bacteroids.

The formation of bacteroids in the light of this view will have then an increased interest.

Nobbe and Hiltner claim that the bacteroids are formed by repeated division of the tubercle germ without the separation into isolated individuals. This continued division usually

[22] Sächs. landw. Zts. *16*: 165. 1893. Landw. Vers. Stat. **42**: 459. 1893.

takes place transversely, and this produces an elongated growth although lateral protuberances often arise making a branched and irregular appearance. They liken the swollen branched bacteroids to a gill respiration, the nitrogen being absorbed by the water and this coming to the absorbing surfaces in a dissolved condition. The fact that nodules are less active in their assimilatory capacity in water cultures than in soil is commented upon and the inference drawn that the slower exchange of gases in the water than in capillary soil is the cause of this lessened activity.

Variety of species of nodule-producing organism.

Regarding the question as to whether there is a variety of species of the nodule forming organisms, Nobbe and Hiltner give some additional experiments in infecting different legumes with bacteria normally found in other species.[23] In nitrogen-free soils, certain plants like *Lupinus luteus*, *L. augustifolius*, *Acacia Lophantha* and *A. Julibrissin* produced tubercles when inoculated with bacteria of pea and bean tubercles. In soil containing nitrogen no infection could be noted, indicating that there must be a nitrogen hunger in the plant before the tubercle bacteria of one species of legume can penetrate the root system of another species.

Atkinson[24] records in his paper the failure to produce tubercles on *Dolichos sinensis* when inoculated with pure cultures isolated from *Vicia sativa* while this organism introduced into its normal host developed abundant tubercles.

The multiplicity of forms that have been noted among the bacteroids of different legume species has led to the view that there are specific forms for different species of legumes. This view receives support from a morphological basis but the uncertainty of a classification based upon a possible involution or abnormal structure is obvious.

Schneider[25] classified the tubercle organisms under the generic title of Rhizobium, adopting Frank's generic name. He based this classification at first on purely morphological characters as they appeared in the living tubercle, but he has since cultivated several forms artificially and has added cultural characteristics to his morphological data.

[23] For earlier data on this question see Landw. Vers. Stat. **39**: 227–359. 1893.
[24] Bot. Gaz. **18**: 157. 1893.
[25] Ber. d. d. bot. Ges. **12**: 11. 1894.

Atkinson has suggested that the influence of the macrosymbiont upon the tubercle organism may have much to do with the variability of form as seen in the different types of bacteroids.

Bearing upon this question of variety of species are the very interesting observations of Bolley[26] on the natural distribution of tubercles on the roots of indigenous and introduced legumes of the western plains. The native flora of the region is distinctively leguminous and he gives a list of native forms that he finds well provided with tubercles under natural conditions of environment. Many of the introduced legumes, especially *Trifolium pratense* often fail to establish themselves in the Dakotas for some reason. On stray plants, self-seeded and alone, he finds few, if any, tubercles, even though they may be growing in the midst of the native leguminous forms, but when preceded by *T. repens* this form develops nodules on its roots and is apparently thrifty. Several other introduced legumes fail to produce tubercles when planted on the virgin soil.

The inability of these species to produce nodular outgrowths would seem to favor the theory that their special organism was lacking and therefore would indicate that there is a variety of species. These observations have, however, only a circumstantial value in lieu of actual infection experiments.—H. L. RUSSELL.

The influence of traction upon the growth of plants.

Hegler in a recent paper[1] points out some of the work done on this subject by other investigators: (1). Baranetzky concluded that the duration and intensity of growth were in no wise affected by traction. (2). Max Scholtz thought that the effect of traction was twofold: (*a*) a retardation which he considered a pathological effect; (*b*) an acceleration in which he saw the real mechanical effect of the traction. The author advances some important objections to these conclusions and then gives an account of his own investigations.

Method.—Two plants were used, one with and one without a weight. Measurements were taken by means of distance marks, microscope and micrometer, or by the Bara-

[26] Ag. Science **7**: 58. 1893.

[1] HEGLER, ROBERT. Ueber den Einfluss des mechanischen Zugs auf das Wachsthum der Pflanze. Beiträge zur Biologie der Pflanzen, **6**: 281. 1894.

netzky registering auxanometer. The curves of both plants were plotted together for comparison. Shoots, petioles and seedlings of the following plants were used. Helianthus annuus, Helianthus tuberosus, Phaseolus multiflorus, Tropaeolum majus, Tropaeolum minus, Ricinus bipinnatus, Linum usitatissimum, Cannabis sativa, and Dahlia variabilis.

I. By a series of experiments, using weights of 20–150^{gm} the conclusion is reached that the retardation of growth is to be regarded as a typical irritation phenomenon. An acceleration of growth takes place as soon as the weight ceases to act as a stimulus; but a new retardation can be produced by upsetting the equilibrium by an increase in weight.

II. The amount of weight necessary to produce a retardation varies in the same individual. Weights of 1.3–5^{gm} are sufficient to call forth a response in some plants, but others require still larger weights.

III. The retardation produced by traction is the greatest at the beginning of the grand period, diminishes towards the maximum, where it is almost nothing, and again increases as we descend the other arm of the curve. Large weights (150^{gm}) call forth a retardation even at the maximum of the grand period.

IV. The same is true for the daily period. If the irritability at the daily maximum is very low, the weight which before called forth a retardation, here produces an acceleration of growth. When a weight which has upset the equilibrium remains constant, the change of stimulus gradually ceases to work and to give place to the mechanical effect. A diminution in the weight also produces a retardation. The retardation then is dependent upon the abrupt change of weights, either an increase or a decrease.

V. By using etiolated specimens, the daily periodicity was avoided, when the retardation was not inhibited at certain phases but remained regular. The etiolated specimens were very sensitive to the weight as a stimulus.

VI. The approximate proportion given by Scholtz between the acceleration and the number of days is an inverse proportion between the weight and the amount of acceleration. For the same number of days the acceleration decreases with the increase of weight and passes with the high weight in the second to fourth day to a retardation of growth.

VII. A new retardation may be produced by a spontane-

ous increase of the sensitiveness to the stimulus; if it continues to increase, an inhibition of the growth in length must result.

VIII. The retardation is not produced by a depression of the hydrostatic pressure. The comparison of the turgor of cells from plants provided with weights and plants without weights showed a higher pressure in the plants subjected to traction. A similar retardation and increase in turgor was produced by gypsum jackets. In roots, especially, the pressure reached a considerable height and is perhaps of considerable biological importance. The investigations of Eschenhagen, Wortmann, and Zacharias are also analogous and showed with increase in turgidity, a retardation or inhibition similar to that produced by traction.—F. D. HEALD, *University of Wisconsin.*

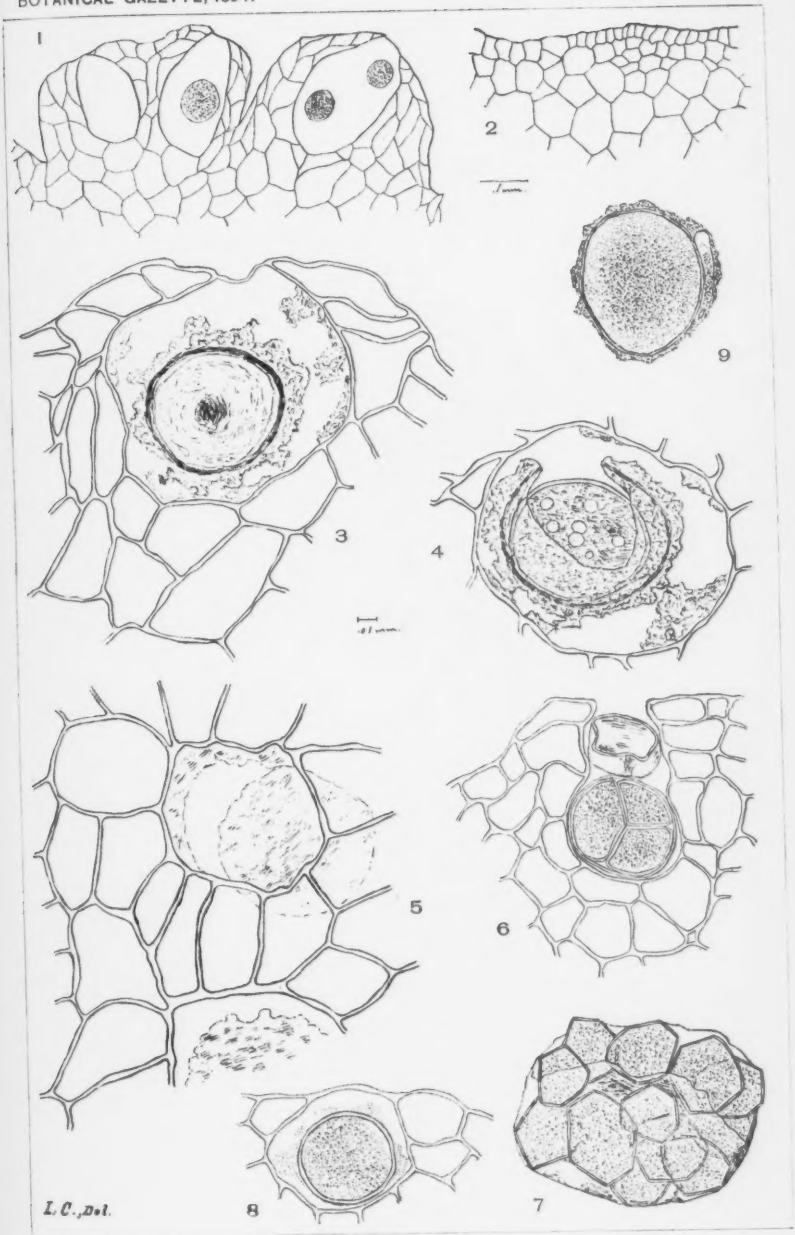
BRIEFER ARTICLES.

Synchytrium on Stellaria media. (WITH PLATE XXVIII.)—Since Farlow and Seymour's Provisional Host-Index of the Fungi of the United States does not report Synchytrium on any species of Stellaria, it is possible that its occurrence upon *Stellaria media* Smith, in the vicinity of Baton Rouge, La., may be of interest to mycologists in this country.

Stellaria media is one of the most common weeds in and around Baton Rouge, and as early as the middle of January of the present year plants growing in low wet places were attacked by the fungus. The presence of the Synchytrium is first indicated to the naked eye by the appearance upon the host of blister-like swellings, each of which, a little later, shows in its center one or more bright yellow spots which, as the fungus matures, change to a reddish brown. The diseased areas show marked hypertrophy (figs. 1 and 2), and the cells of the host are deprived of their chlorophyll and finally of their entire protoplasmic contents. The lower internodes of the stem and the petioles and midribs of the leaves are favorite areas of attack, but if damp weather favors the development of the fungus, no aerial part of the host escapes, and the disease spreads to leaf-blades, pedicels of the flowers, calyx leaves, petals and even to stamens and pistils, everywhere swelling and distorting the tissue, dwarfing the growth and finally killing the plant.

A cross section of the stem where the spots in the pustules have turned reddish brown shows numerous resting-spores occupying cavities that are apparently much enlarged epidermal cells (figs. 1, 3, 4). The normal number of resting-spores in each cavity is one, though quite frequently two and even three are found, in which case they are usually somewhat reduced in size. The upper wall of the epidermal cell in which the spore forms becomes quite thin and often breaks and disappears entirely (figs. 3 and 5).

The resting-spores are spherical, thick-walled, reddish brown in color, with surfaces roughened by a deposit of coarse, irregularly shaped granules. Within this outer granular coat is a thick, darker brown, more compact layer; this has not the homogeneous appearance of most cell walls, but seen in section shows numerous thin, overlapping laminæ, no single one of which can be traced continuously around the circumference of the spore. Within the laminated coat is a colorless, rather delicate membrane enclosing a dark, granular substance



CLENDENIN on SYNCHYTRIUM.

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that carries in it many oil globules (fig. 4). The resting-spores show considerable variation in size, and differ noticeably in the roughness of the outer surface.

Along with the resting-spores, though in separate cavities, are occasionally found sori composed of a varying number of angular, polyhedral sporangia enclosed in a delicate, transparent sac (figs. 6 and 7). Each sporangium has a thin, colorless wall and finely granular contents that are colorless when the sporangium is first formed, but change to a bright yellow as it matures.

A section through a leaf or stem where the disease is in its earlier stages shows many of the epidermal cells slightly enlarged and occupied by almost transparent spores that range in size from extremely small spheres to that of the average mature resting-spore. Now these may be early stages of either resting-spores or sori, but since in older diseased tissue, resting-spores are many times more numerous than sori, it seems probable that most of the immature bodies are resting-spores in process of formation (fig. 8).

The size of the resting-spores and their rough, reddish-brown covering agree with the description of *Synchytrium Stellariæ* Fuckel as given by Schroeter[1] and Fischer,[2] as do also the size of the sori and the variable number of sporangia. The host, too, is the same. The contents of the sporangia, however, are bright yellow instead of orange-red, but it is possible that those examined were not yet mature.

Schroeter states that in the same cavity with the sorus and lying just above it, is always found an empty membrane. He explains this as the original wall formed around the swarm-spore after it enters the epidermal cell of the host, and out of which, through an opening at its lower pole, the contents pass when ready to form a sorus. De Bary[3] mentions this membrane as indicating a possible sexual origin for the sorus, but thinks Schroeter's explanation probably the correct one. This may also explain the empty membrane represented in fig. 6.

Some of the resting spores, in their earlier stages, show a pouch like body closely adhering to the outer surface (fig. 9). It is barely possible that both sori and resting-spores result from the conjugation of the swarm-cells.

So far, all efforts to induce the resting-spores to germinate have been unsuccessful, and the writer is not able to state whether their contents first break up into sporangia, or pass directly into swarm-cells.—IDA CLENDENIN, *Baton Rouge, La.*

[1] Schroeter, Krypt. Flora Schles. Pilze, 189.

[2] Fischer, Rabenhorst's Krypt. Flora von Deutschland, Œsterreich und der Schweiz. I: Abthl. IV. 52.

[3] De Bary, Comp. Morphol. and Physiol. of Fungi. 168.

EXPLANATION OF PLATE XXVIII.—Fig. 1. Section through two pustules on stem of Stellaria media. × 105.—Fig. 2. Cross section of healthy stem. × 105.—Fig. 3. Cross section of receptacle and resting-spore, the latter emptied of its contents. × 425.—Fig. 4. Resting-spore with outer thick coat broken and showing the endosporium. × 425.—Fig. 5. Surface view of epidermis of diseased part. × 425.—Fig 6. Section through an upper internode, showing two sori in a common receptacle, one sorus emptied of sporangia. × 425.—Fig. 7. A larger sorus. ×425.—Fig 8. Section through a younger pustule, showing an immature resting-spore or sorus. × 425.—Fig. 9. Young resting-spore with membrane attached to one side. × 425.

A peculiar malformation of an ovary and placenta on Begonia rubra-grandiflora.—Last spring while engaged in a series of cross fertilization experiments, I observed a very peculiar ovary and pistil in one of the flowers I had crossed. It was Begonia rubra-grandiflora and it had been fertilized by pollen from Begonia Verschafeltii with all the usual precautions against accidental fertilization from other sources. The ovary was superior instead of inferior, as it is normally. The four branches of the stigma seemed to be attached to the sides of the ovary near the base; or rather the ovary seemed to have grown up in the middle of the flower pushing the four branches of the stigma apart. The ovary also seemed to be turned wrong side out, exposing the parietal placenta on its outer surface, which was apparently covered with tiny whitish ovules. No capsule was developed below the base of the calyx, as in a normal pistillate blossom. These ovules or seeds could be seen very distinctly four or five days after fertilization, without a lens.

Unfortunately, after about ten days of growth, this peculiar ovary was accidentally broken off; but the stem was placed in water under a bell jar until the seeds became brown, and seemed ripe. Though the seeds seemed shrivelled when dry they were nevertheless planted; but none germinated.

This malformation was so curious (and so far as I could find unrecorded), that I would not trust my own observation, but showed the plant to several botanical students, and to Prof. A. S. Hitchcock, and Mr. M. A. Carleton, all of whom agreed with me that these small bodies on the outside of the ovary appeared to be seeds. Some were scraped off with a scalpel and examined under a microscope; and to all outward appearances seemed to be genuine seeds.

I have never read of a similar freak, so think this instance might be of interest to other botanists.—MINNIE REED, *Botanical Department, Kansas Agric. College, Manhattan.*

CURRENT LITERATURE.

Embryology of the Amentiferæ.

A recent paper[1] upon this subject, by Miss Margaret Benson, contains some remarkable results. Embryologists have long looked hopefully at the Amentiferæ as a possible fruitful field for the discovery of certain homologies of the phanerogamic embryo-sac. The results here recorded have been obtained from work that has been going on since 1891, in the botanical laboratory at Cambridge, at the suggestion of Professor Oliver. The material was difficult to obtain in the right stages and much time elapsed before satisfactory results could be obtained. The present paper is but preliminary and fragmentary, but it contains results that deserve announcement. British forms of Fagus, Castanea, Quercus, Betula, Alnus, Corylus and Carpinus are considered. A comparison is instituted with Treub's results with Casuarina, indicating the close affinity of that genus with the Amentiferæ. Treub, it will be remembered, considered the chalazal entrance of the pollen-tube a fact of sufficient importance to set off the chalazogams (represented by Casuarina) against all other phanerogams (porogams). It now seems that Alnus, Betula, Corylus and Carpinus are also chalazogams. The adaptations to this chalazal entrance are well pointed out. Other striking similarities are to be found in the development in the Amentiferæ of genuine "sporogenous tissue" in the nucellus, several similar contiguous cell-strands, from which one or more embryo-sacs are developed; and in the prevalence of cæca formed by the embryo-sac (tails of macrospores) which serve for the unimpeded pathway of the pollen-tube up the nucellus, as in Casuarina, or forage for the needs of the embryo, as in Fagus. It is a question for which of these purposes the cæca were originally acquired. In Castanea, also, there is a somewhat inconstant development of tracheids around the base of the embryo-sac, as in Casuarina, taken to suggest some ancestral organ. The remarkable branching and resting stage of the pollen-tube found in the group is also suggestive of Casuarina. No intimation as to the homologies of the antipodal cells or as to the nuclear fusion of the embryo-sac was obtained. The group is evidently one worthy of exhaustive study, and likely to bring us somewhat nearer the solution of the problem as to the genesis of phanerogams.

[1] Benson, Margaret. Contributions to the embryology of the Amentiferæ, Part I. Reprint from Trans. Linn. Soc. II. **3**: 409–424. *6 pl.*

Minor Notices.

A LIST of the vascular flora of Rensselaer county, N. Y., has been published by Drs. H. C. Gordinier and E. C. Howe. The list enumerates 1345 species and varieties. The first list of the county was prepared by Professor Amos Eaton and Dr. George Marvin in 1819, under direction of the Troy Lyceum.

ANOTHER BULLETIN devoted to the "Russian thistle" (Salsola Kali tragus) has just been issued by the Department of Agriculture, having been prepared by Mr. L. H. Dewey of the Botanical Division. It gives an account of the introduction and spread of this weed, and suggests remedies. The map of present distribution shows that the Dakotas and Nebraska are chiefly infested, but dangerous looking patches are beginning to appear in Minnesota and Iowa.

A VALUABLE work for lichenologists is vol. I of "British Lichens" by Rev. Jas. M. Crombie, A. M. It forms the first half of a monograph of British lichens based on the collections contained in the British Museum. The large number of type specimens, not to be found elsewhere, and the very full collections from all parts of the British Isles have enabled the author to make his work unusually complete and valuable. The distribution of species is given very fully. A series of about seventy-five figures illustrate the general structure of the sixty-six genera described. The second volume is promised for next year.

THE FIRST PART of a preliminary revision of North American Cactaceæ by Dr. John M. Coulter has been issued by the Department of Agriculture. The work has been in hand since 1890, and has been conducted, with the help of various assistants, in the field, in the Engelmann collection of notes and types, and in the study of all accessible American collections. The nature of the material and the frequent loss of types have made the study exceedingly difficult; while the numerous garden names and descriptions of the older writers have made an inextricable synonymy. The Mexican boundary is disregarded, aud all species that have come under observation and are reasonably certain are included. The present part contains three genera: *Cactus*, replacing the generic name, Mamillaria, under which 64 species and varieties are defined, twelve of which are new; *Anhalonium*, with 4 species; and a new genus, *Lophophora*, proposed for Echinocactus Williamsii, with a species and variety. Geographical distribution is discussed, so far as meager information will allow, and a handy artificial key is provided for the species of Cactus. The numerous notes left by Dr. Engelmann, including descriptions of unpublished species, have added greatly to the value of the revision.

NOTES AND NEWS.

In *Meehan's Monthly* (June) will be found a portrait of Dr. Wm. Baldwin.

In *Erythea* (June) Mr. J. G. Lemmon describes and figures a new Pinus of S. E. Arizona, named from that "Apache-infested" region *P. Apacheca.*

Stephen Elliott is honored in *Garden and Forest* (May 23) by a biographical sketch, with portrait, and also by a full description and figure of Elliottia racemosa.

Professor von Sachs of Würzburg continues his physiological notes in *Flora.* The last note forms an exceedingly interesting paper of 28 pages, on mechanomorphoses and phylogeny (Flora —: 215–243. 1894).—Bay.

A translation of Kerner's admirable *Pflanzenleben* has been made by Professor Oliver and Misses Busk and Ewart and is already in course of publication in sixteen monthly parts by Messrs. Blackie & Son, London and Glasgow.

The *Journal of Botany* for June is largely devoted to tropical African plants, Mr. A. B. Rendle describing some new Asclepiads (one a new genus), and in connection with Mr. James Britten describing several new Convolvulaceæ.

Messrs. Morris & Wilson of Minneapolis announce the publication of a translation of Dr. Walter Oels' little manual of experimental plant physiology by Mr. D. T. MacDougal of the University of Minnesota. We shall present a fuller notice of the book later.

In the *Kew Bulletin* (May) is published a list of fifty-two plants collected by Dr. W. L. Abbott, an American naturalist, on the Aldabra Islands (north of Madagascar), and named by Mr. J. G. Baker. The collection contains ten new species, but not a single fern, grass, orchid, or composite.

Mr. Charles L. Pollard publishes an enumeration of the Cassias of North America north of the Mexican boundary in *Bull. Torr. Bot. Club* for May. Twenty-seven species are recognized, two of which are new, both from the Gulf states. The synonymy of the genus seems to be remarkably simple and unvexed.

Heft four of the *Berichte* d. deutschen botan.Gesellschaft contains: Johann Bachmann, on the influence of external factors upon the formation of the sporangia of *Thamnidium elegans* Link; H. Potonié, on the position of the *Sphenophyllaceæ* in the system; J. Christian Bay, *Sachsia,* a new genus of the yeast-like fungi which does not cause alcoholic fermentation.—Bay.

The *Bulletin de l'Herbier Boissier,* in recent numbers (April and May), published a series of botanical studies of the islands of the Le-

vant by C. J. Forsyth Major and William Barbey; a comparative study of the genus Thunbergia by Charles Roulet; and new plants from the eastern slopes of the Caucasus, by N. Alboff, many of which have strong North American affinities.

IN THE *Bulletin* of the College of Agriculture of the Imperial University of Japan, (2: 1–33) is a paper by Prof. O. Loew, on the energy of living protoplasm. This paper outlines the history of protoplasmic action in view of the discoveries of Loew and Bokorny. Prof. Loew brings together a series of new facts about the occurrence and rôle of the active albumen, which he has found in very many trees, leaves as well as flowers.—BAY.

IN THE *Bulletin of the Torrey Botanical Club* (June) Dr. Britton publishes a revision of the genus Lechea, having succeeded Mr. Leggett in its study. The species are difficult to discriminate and hence have been much confused in collections, necessitating a study of the types, which have not always been forthcoming. Dr. Britton recognizes fourteen species. In the same number Mr. Bicknell separates *Helianthemum majus* (L.) from our H. Canadense, with which it has been confounded; Mr. Kearney describes several interesting plants from the southern states; and Professor Underwood describes a new Selaginella from Mexico.

THE FOLLOWING changes have occurred in addresses of botanists from January to June, 1894, in addition to those already noted in these pages: Dr. W. Saposchnikoff, formerly in Moskow, now at the University of Tomsk; Prof. F. Delpino has gone from Bologna to the Botanic Gardens at Naples; Dr. Giessler (Göttingen) was called to Lauterbach by Fulda as assistant in the Centralmolkerei; Prof. Zacharias of Strassburg was called to Hamburg as custos of the Botanic Gardens; Prof. Julius Klein is now at the Naples Zoological Station; Dr. W. Scott has gone to Mauritius as Director of Forests and of the Botanic Gardens; Dr. R. Otto, formerly at Berlin, is now at the Royal Pomological Institute at Proskau, O. S.; Dr. Fr. Krüger of Geisenheim took Dr. Otto's position at the Kgl. Landw. Hochschule at Berlin; Henry O. Forbes is now Director of the Museum at Liverpool, Eng.; Prof. O. Mattirolo is now at the Botanic Gardens at Bologna (instead of Prof. Delpino); Dr. C. Avetta is at Parma; Dr. Cesali is now first assistant botanist at the University of Rome; Prof. D. Lovisato has been called to the Botanic Gardens at Cagliari, as professor of botany; Arturo Baldini was elected custos of the Botanic Gardens at Bologna; G. F. Sarauw was elected assistant at the National Museum, Copenhagen, Denmark; J. E. Willis, recognized lecturer in Botany at Cambridge, was elected senior assistant in Botany and lecturer at Queen Margaret College in Glasgow, Scotland.—BAY.